

ON THE CRETACEOUS AGE OF THE SO-CALLED
JURASSIC CHEILOSTOMATOUS POLYZOA
(BRYOZOA)

A CONTRIBUTION TO THE KNOWLEDGE OF THE
POLYZOA-FAUNA OF THE MAASTRICHTIAN
IN THE COTENTIN (MANCHE)

BY

EHRHARD VOIGT

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A CONTRIBUTION TO THE KNOWLEDGE OF THE POLYZOA-FAUNA OF THE MAASTRICHTIAN IN THE COTENTIN (MANCHE)

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SYNOPSIS

The supposed Jurassic cheilostomatous Polyzoa described by J. W. Gregory (1894) as *Membranipora jurassica* and *Onychocella bathonica* from the Bathonian of Ranville (Calvados), are of Cretaceous age and must have come from the Maastrichtian of the Cotentin (Manche, France). The matrices of the type specimens yielded thirty-three further species of Maastrichtian Polyzoa of which nine are Cyclostomata and twenty-four Cheilostomata. Three new species *Radulopora minor* n. sp., *Rosseliana thomasi* n. sp. and *Fruvionella fertilis* n. sp., and the new genus *Radulopora* are described.

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I. INTRODUCTION AND ACKNOWLEDGMENTS

THE predominant orders of Polyzoa (Bryozoa) of the Cretaceous and Cainozoic periods are the Cyclostomata and the Cheilostomata. The Cheilostomata have been increasing ever since an explosive development in the Upper Cretaceous, whereas the Cyclostomata have decreased during the Tertiary and Quaternary following a flourishing period in the Cretaceous. Today there exists only a comparatively small relic of this cyclostomatous fauna stem which, in Jurassic times, was the only living group of Polyzoa apart from some rare species of boring Ctenostomata.

This last statement contradicts all textbooks of palaeontology in which the Cheilostomata are being erroneously recorded as beginning at the latest in the Jurassic, an opinion repeated by R. S. Bassler (1953).

It is the purpose of this paper to prove that the so-called Jurassic Cheilostomata described by Gregory (1894) from the Bathonian of Ranville (Calvados), are in fact

Upper Cretaceous in age and must have their origin in the Maastrichtian of the Cotentin (Manche) in Normandy.

Other Jurassic Polyzoa described as Cheilostomata by several authors do not belong to that order but are true Cyclostomata. In any case it must be emphasized that, if they are undoubtedly Jurassic, they are not Cheilostomata, or if they belong to that order they are not Jurassic.

I wish to record my warm appreciation of the late Dr. Dighton Thomas of the British Museum (Natural History) to whom I am very much indebted for studies in the Museum collection, for the loan of specimens, for discussion, and for his help and advice. At the time of his death he had begun tidying the English of the manuscript, and this was kindly finished by Dr. J. M. Hancock. I am also grateful to Dr. A. B. Hastings for interesting discussions about the subject. Grateful thanks are due to Prof. J. Lehman, Dr. J. Sornay and Dr. E. Buge of the Musée d'Histoire Naturelle (Paris) for permission to study and to photograph the types of Bryozoa in the d'Orbigny-Collection. I also wish to thank Dr. J. Roger, Paris, for kindly accompanying me and guiding me in the Maastrichtian territory of the Cotentin and other French classic localities. Finally my special thanks are due to the Deutsche Forschungsgemeinschaft for financial help to further this research and their support for my studies on Cretaceous Polyzoa.

II. CHEILOSTOMATA OF CRETACEOUS AGE DESCRIBED FROM JURASSIC BEDS

Considering first the ages of undoubted Cheilostomata which have been described as Jurassic forms, we can enumerate the following three species: *Flustra flabelliformis* Lamouroux 1821, *Onychocella bathonica* Gregory 1894, and *Membranipora jurassica* Gregory 1894.

I. "*Flustra*" *flabelliformis* Lamouroux 1821

1821 *Flustra flabelliformis* Lamouroux: 113, pl. 76, figs. 11-13.

This species, described in a footnote and figured by Lamouroux, apparently from Ranville, is a fanlike fragment of a bilaminar *Onychocella*. The very simple figure shows pyriform zooecia with round orifices increasing in size to the periphery of the frond. An avicularium, rounded distally, seems to be indicated. Below the broken cryptocyst the rectangular or box-like pattern of the zooecia is visible. The original diagnosis of Lamouroux is:

"*Flustra* en forme d'éventail, fossile, épaisse, à bords entiers, composée de deux membranes, une supérieure mince, un peu translucide, divisée en alvéoles profonds, à bords irréguliers avec un oscule rond dans le centre, qui communique à une cellule en forme de carré long, très régulier, avec des cloisons épaisses et solides, les transversales alternant entre elles, les longitudinales se prolongeant sans interruption de la base aux extrémités; grandeur, 2 à 3 centimètres; épaisseur, environ 1 millimètre."

Unfortunately there is no possibility of restudying the typespecimen because, according to Sherborn, Lamouroux's collection has been lost. Nevertheless, there is no doubt that the specimen is not from the Bathonian of Ranville as supposed by Gregory, but must be regarded as a Cretaceous *Onychocella*, likely to have come from one of the Maastrichtian localities of the Cotentin (Manche), as is demonstrated for the two following species. Lamouroux himself gives as the origin only the neighbourhood of Caen, which perhaps includes not only Ranville but also the Cotentin.

Gregory (1896 : 214) in his Catalogue of the Jurassic Bryozoa in the British Museum suppressed his specific name *bathonica* for an *Onychocella*, regarded by him in 1894 as a new species from the Bathonian of Ranville, in favour of Lamouroux's species because he believed that the two forms were identical.

As will be shown, Gregory's *Onychocella bathonica* is the well-known Maastrichtian *Onychocella piriformis* Goldfuss 1826 first described from the "Maastrichter Tuffkreide" in the Netherlands. If Gregory was correct in identifying his *Onychocella bathonica* with *Flustra flabelliformis* Lamouroux, the latter name has priority. On the other hand Lamouroux's figure is rather unsatisfactory, as Gregory himself stated, for a conclusive identification of *Flustra flabelliformis* Lamouroux with *Onychocella piriformis* Goldfuss. There are so many similar species of *Onychocella* in the Upper Cretaceous that it seems to be quite impossible to find out which species was intended by Lamouroux under this name. Gregory notes that Lamouroux's figure is so indefinite that Pictet gave a figure of a form, which he referred to this species, which was really *Diastopora lamellosa* Michelin. It is probable that Gregory, in identifying his *Onychocella bathonica* with *Flustra flabelliformis*, was influenced by his supposition that they are of Bathonian age, and as Jurassic species of *Onychocella* must be very scarce, he believed that they must be identical.

2. "***Onychocella bathonica***" Gregory 1894

(= *Onychocella piriformis* Goldfuss 1826)

(Pl. 5, figs. 11-12)

1826 *Eschara piriformis* Goldfuss: 23, pl. 8, fig. 10.

1851 *Eschara piriformis* (Goldfuss) von Hagenow: 75, pl. 9, fig. 6 and pl. 11, fig. 6.

1894 *Onychocella bathonica* Gregory: 63, fig. 2

1896 *Onychocella flabelliformis* (Lamouroux); Gregory: 214, fig. 22.

1930 *Onychocella piriformis* (Goldfuss); Voigt: 454, pl. 16, figs. 1-2.

This is the supposed Jurassic cheilostomate which was described and figured by Gregory under this name in 1894 and, as stated above, later treated by him as a synonym of "*Flustra flabelliformis* Lamouroux. The first mention of a "Jurassic *Onychocella*" was made by Gregory (1893 : 239). It is represented in the British Museum Collection by two specimens, D.181 (type) and D.480, both from the Tesson-Collection. As previously suggested by the present author (Voigt 1930 : 454), these two specimens are not from the Bathonian "Calcaire à polypiers" as recorded

by Gregory, but both are Upper Cretaceous in age. This is proved firstly by a Cheilostomatous Polyzoan, *Stamenocella marginata* (d'Orbigny) which is visible in the matrix of specimen D.181 (Pl. 3, fig. 1) and which was overlooked by Gregory, and secondly by a large fauna of other Maastrichtian Polyzoa which has been isolated from the adherent matrix of the block D.181 and which is described in section VI. This study shows clearly that all these supposed Bathonian Polyzoa are in fact of Upper Cretaceous age as already indicated for "*Membranipora jurassica*" by Lang (1916 : 96, 97 and 1922 : 197-198) and Larwood (1962 : 223).

Onychocella bathonica Gregory is the same species as *Onychocella piriformis* (Goldfuss) 1826 from Maastricht. It is quite commonly found in various localities of the French Cotentin (Manche). Although Gregory has discussed Goldfuss's species and written that it has a lower zoecial aperture, while the avicularian aperture is larger and the front wall occurs only above and not on both sides of this, a comparison with a specimen from Chef du Pont indicates that they are synonyms (pl. 5, fig. 11). The supposed differences are not significant and they are not found when material from Maastricht or from the Cotentin localities is used for comparison. Some of the opesiae¹ in the figured (pl. 5, fig. 12) British Museum specimen D.181 are a little smaller than those of the figured specimen from Chef du Pont (pl. 5, fig. 11), but there are variations within the same specimen. Gregory's figure is deceptive because it shows a small quadrangular fragment with only five whole zoecia and one avicularium; it does not correspond in size to his two originals. The Holotype of *Onychocella bathonica* Gregory is a large bent unilaminar frond of nearly 3 cm. length (pl. 5, fig. 12). It contains a dozen avicularia and shows, on some zoecia, the very small characteristic endozoecial ovicells which are just visible as minute swellings at the distal ends of the zoecia figured here (pl. 5, fig. 12). The other specimen D.480 is a large unilaminar fragment of 11 × 8.5 cm. size with four avicularia.

In discussing the affinities of *Onychocella flabelliformis* (Lamouroux) Gregory maintains that its nearest ally may be von Hagenow's *Cellepora (Discopora) koninckiana* (1851 : 95, pl. 11, figs. 11-12) from Maastricht, a species which, with its straight rows of avicularia and small zoecia, is very differently shaped. In discussing *Onychocella* (= *Cellepora*) *koninckiana* (1896 : 215) he distinguished the form figured by von Hagenow in his fig. 11 as a new species—*Onychocella hagenowi*. He assigned it to a separate species because he believed that it has larger elliptical opesiae with the longer axis longitudinal, an entire lower margin of the opesia and much larger avicularia. This example shows how dangerous it is to judge the variability of species on the evidence of figures alone. Von Hagenow was quite correct in considering the two forms as only one species because they can often be observed in the same zoarium as confirmed by Voigt (1930 : 460).

The first known species of *Onychocella* are from the Cenomanian, and they are small and of a lower level of evolution. Judging from this point of view it would be very odd if the oldest species should have the largest zoecia of the genus, more than 1 mm. long, and big avicularia 1.3-1.4 mm. in length as these are otherwise developed only at the acme of the Onychocellids in the late Upper Cretaceous.

¹I have followed the advice of Dr. Hastings in using "opesia", plural "opesiae", rather than "opesium", plural "opesia".

3. *Castanopora jurassica* (Gregory) 1894

(Pl. 7, figs. 4-7)

- 1894 *Membranipora jurassica* Gregory: 62, text-fig. 1.
1896 *Membranipora jurassica* Gregory: 212, text-fig. 21, p. 213.
1916 *Rhiniopora jurassica* (Gregory) Lang: 96.
1922 *Rhiniopora scabra* Lang: 196, pl. 4, fig. 7, text-fig. 62.
1922 *Rhiniopora jurassica* (Gregory) Lang: 197.
1962 *Castanopora jurassica* (Gregory) Larwood: 223, pl. 17, figs. 3-5, text-figs. 108-109.

Holotype D.180, large bilaminar fragment of damaged zoarium partly embedded in matrix. Upper Maastrichtian, Cotentin, Manche, France (not Maastricht, Netherlands).

Lang recognized the cribrimorph nature of this species. It was overlooked by Gregory that the cribrimorph structure of the frontal-shield was preserved quite well in some zooecia of the type specimen D.180 (Tesson Coll.) which was figured by Larwood (1962 : 224, text-fig. 108, pl. 17, fig. 5). Although Gregory described it correctly as "erect foliaceous, bilaminar", Lang defined this form as "encrusting unilaminar" as did Larwood (1962). Dr. Dighton Thomas and Dr. A. Hastings were kind enough to confirm my first observation made in the Museum collection that Gregory's type specimen is bilaminar and not encrusting.

Gregory, misled by the erroneous data of Tesson's label, recorded the species as coming from the Bathonian of Calvados. Lang (1922 : 197) recognizing the Maastrichtian age, supposed that it originated from the Dutch locality Maastricht itself, and recorded the distribution of this species as, "Senonian, Maastrichtian, Maastricht, Limburg, Holland", specimen D.3313 being labelled "Maastricht, Old collection". Larwood (1962, pl. 17, fig. 3) followed Lang and gave a photograph of this specimen. I am much indebted to Dr. Dighton Thomas for lending me D.3313, for there is no other record of *Castanopora jurassica* from Maastricht, and the specimen may have come from the same locality as D.180. Dr. Dighton Thomas compared the matrices of these two specimens: they are very similar in colour, grain size, and in size of fossil debris, and they could have come from the same locality in the Cotentin.

As will be shown in section IV of this paper, the type locality cannot be Maastricht in Holland, but must be the same as that of the last species, a locality in the Cotentin. The matrix of the type specimen D.180 is a hard, Polyzoan-bearing, detrital limestone, resembling very much the "Craie à Baculites" or "Craie à Thécidées" of the Cotentin. Lang has already recognized some other Cheilostomata in the matrix of this block. They are described and figured here under the name of *Multicrescis laxata* d'Orbigny, *Rosseliana thomasi* n. sp. and *Pliophloea* sp. These species are unknown from Maastricht itself, and combined with the results above on "*Onycho-cella bathonica*", there can be no doubt that the two species both come from the Cotentin.

All this is now confirmed by the fact that I have found four fragments of "*Castanopora*" *jurassica* (Gregory) in my material from Chef du Pont (Cotentin, Manche).

Dr. Dighton Thomas kindly compared them with the holotype, and he has no doubt that they represent the same species. They agree in measurements, in number of costae, and all other characteristics. All are bilaminar with the exception of a young zoarium which is unilaminar and whose zooecia are only 0.09–1.00 mm. long. In the others the very large zooecia are about 1.2–1.4 mm. long. There are about twenty-six to thirty-four costae with eight lateral costal fusions as stated by Larwood. Pl. 7, fig. 5 shows an instructive view with some zooecia, one of which has preserved its undamaged cribrimorph front wall; the others are broken and show the “membranimorph” habit of Gregory’s figure. On the reverse side of the specimen (Pl. 7, fig. 4) are some zooecia with the characteristic ovicells of the genus which were previously not known in full preservation. They are hyperstomial and globular, prominent, and overlapping the distal zooecium as presumed by Larwood. They are perforated by isolated fine pores (invisible in my figure) as in *Castanopora guascoi* Ubaghs from Maastricht.

It must be emphasized that *Castanopora jurassica* (Gregory) has never been found near Maastricht, although I have studied the Polyzoa of the Maastrichtian Tuffkreide for 40 years. Near Maastricht another allied bilaminar form is represented, *Castanopora guascoi* (Ubaghs) (1865 : 51, pl. 2, fig. 3), whose zooecia in some cases reach a length of 1.5 mm. but which has fewer costae (fifteen to twenty-two). Specimens like these were described by von Hagenow as *Cellepora* (*Dermatopora*) *faujasi* (von Hagenow : 1851, p. 99, pl. 10, fig. 19). It is impossible to mistake *Castanopora guascoi* for *Castanopora jurassica* (Gregory), but it is of interest that, if the costae are broken down, this species gives the appearance of *Membranipora bipunctata* (Goldfuss 1826 : 26, pl. 9, figs. 7a–b), traces of costae being no longer visible. The Cotentin fauna contains further allied bilaminar and unilaminar species which could be mistaken for *Castanopora jurassica*, but there is little room to discuss them. *Rhiniopora scabra* Lang 1916 from Rügen is, according to Larwood, a synonym of *Castanopora jurassica* Gregory, because it agrees in general with the number of costae, and in having 8 lateral costal fusions and pelmatidia.

In a recent work (Voigt 1968 : 65) finished before the issue of the present paper, the genus *Rhiniopora* Lang 1916, united with *Castanopora* by Larwood (1962), is maintained at least as a subgenus of *Castanopora*.

SPECIMENS:

D.3313. Large fragment partly embedded in matrix, recorded by Lang (1922 : 197) and figured by Larwood (1962, pl. 17, fig. 3), labelled “Maastricht, Old collection”, but certainly from a locality of the Cotentin-Maastrichtian, Manche, France.

D.49724. Small bilaminar fragment with three ovicelled zooecia. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Collection E. Voigt.

D.49725. Young unilaminar zoarium with some damaged zooecia. Horizon and locality as above. Collection E. Voigt.

Some fragments. Horizon and locality as above. In Collection E. Voigt, Hamburg, Nr. 3585 and 3924.

III. POLYZOA FROM JURASSIC BEDS WHICH HAVE BEEN REFERRED TO THE CHEILOSTOMATA

It is now evident that the above mentioned Cheilostomata are not Jurassic. There are scattered records in the literature of Cheilostomatous Polyzoa whose Jurassic age is undoubted. In all such cases suspicion rises that they are not Cheilostomata. The fallibility of many of these records depends on the progress of science and today nobody can take seriously mention of Cheilostomatous genera like *Hippothoa*, *Eschara*, *Cellaria* or *Cellepora* etc. from the Jurassic by early authors. However, Gregory (1894 : 61) in his note on the Jurassic Cheilostomata considered *Eschara ranvilliana* Michelin from the Bathonian of Ranville, and *Cellaria smithi* Phillips from the Cornbrash of Scarborough, as true Cheilostomata and cited them in support of his theory of the existence of Jurassic Cheilostomata. In his Catalogue of the Jurassic Bryozoa (1896 : 56 and 127) *Cellaria smithi* Phillips is assigned to *Stomatopora* and *Eschara ranvilliana* Michelin to *Diastopora* with no mention that they were regarded as Cheilostomes by himself two years earlier.

F. D. Longe (1881) was still convinced that *Eschara ranvilliana* Michelin from the Bathonian of Ranville belonged to the Cheilostomata when he wrote: "It is perfectly clear, however, that some of the Oolitic *Escharoids* themselves possess the characteristic cell features of the Cheilostomata in a marked degree; and their affinity to the Cheilostomatous *Escharidae* has been recognized by no less authorities than d'Orbigny and Michelin".

He gave a detailed analysis of the supposed cheilostomatous features of this species and related forms, and tried to derive the Cheilostomata from certain Oolitic Diastoporids whose zooecia remind one, by their oval or polygonal shape, of the Cheilostomata. ("The decumbent cells in *Diastopora* may be regarded as ancestral Cheilostomatous cells, and *Diastopora* itself as the parent stock from which many, if not all, of the families of the Chalk and subsequent periods, grouped as *Cheilostomata*, have been derived".).

Walford (1894) published a note "On Cheilostomatous Bryozoa from the Middle Lias". Under the new generic name *Cisternifera* he described some species of cyclostomatous Bryozoa with large heterozooecia—so-called "cistern-cells"—whose relationship with the ovicells of the Cyclostomata was already assumed by Walford. They were thought to bear, occasionally, minute avicularia on the upper lip of the zooecia. Apart from the question of whether these structures are avicularia or not, the different forms attributed to *Cisternifera* are true Cyclostomata, and Gregory (1896) himself has distributed them amongst the genera *Diastopora* and *Entalophora*.

Cellepora davaiacensis Lissajous 1923 from the Bathonian of the Macon district (France), from whose generic name one would expect it to be a Cheilostomatous Polyzoan, and which Lissajous has compared with the Cheilostome *Cellepora polythele* Quenstedt, has been recognized by David (1952) as belonging to the Calcispongia, probably of the genus *Synopelta* Zittel. The list of literature on Jurassic Polyzoa published by David (1960) contains many references to records of Cheilostomata in other works.

From these investigations it is now certain that all supposed species of Jurassic Cheilostomata prove to be mistaken identifications or erroneous stratigraphic records.

IV. ON THE ORIGIN OF GREGORY'S " JURASSIC CHEILOSTOMATA "

In the Cotentin (Manche) Upper Maastrichtian a lithology similar to the " Tuffkreide " from Maastricht itself has long been known. The facies in the Cotentin is a " tuffaceous " detrital limestone with remains of many Foraminifera, Polyzoa, Echinoderms, Brachiopods (Craie à Thécidées ") or hard limestones (Craie à Baculites). It is true that certain blocks of these rocks can be easily mistaken for genuine " Maastrichter Tuffkreide ", because many of the small fossils which make up the rock are common to both strata.

An important difference is the absence of any larger foraminifera like *Orbitoides*, *Lepidorbitoides*, *Siderolites* or *Omphalocyclus* etc. which are distinctive of the Upper Maastrichtian in Holland and Belgium. Hofker (1959) in his monograph on the Foraminifera of the Cotentin Maastrichtian has shown that these beds must be intermediate in age between horizons Cr 4 and Mb in the terminology of Uhlenbroeck for the Upper Cretaceous in South Limburg. This would indicate a stratigraphic position between the phosphatic chalk of Cibly and the base of the Tuffaceous chalk of St. Symphorien in the Mons basin, or an equivalent of the higher beds of Folx-les-Caves and Orp-le-Petit in northern Belgium. This could explain the lack of larger Foraminifera in this region which did not invade the northern regions before the higher horizons of the Maastrichtian. The Maastrichtian age is based upon the occurrence of *Scaphites constrictus* J. Sowerby in the area of Valogne. For the other fauna see Vieillard & Dollfus 1875.

In 1957 I visited the Cotentin region in order to study the classic Senonian localities of d'Orbigny (1850-54) who had described from here, chiefly from Néhou and from Sainte Colombe, some hundred species of Polyzoa. Although there were no extant exposures in the immediate neighbourhood of these villages, some larger quarries near Fresville and Port Filiolet and an excavation for the dairy of Chef du Pont supplied material which furnished examples of a considerable part of the Maastrichtian Polyzoa which were described and figured by d'Orbigny. (For the site

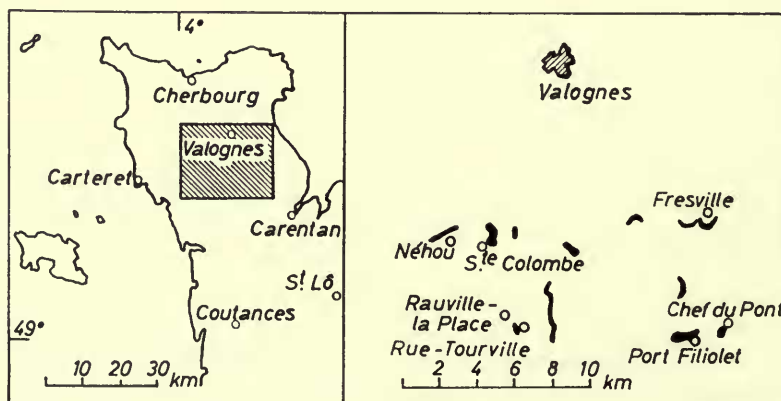


FIG. 1. Map of the outcrops (black) and the localities of the Maastrichtian in the Cotentin area (Normandy). (After Carte géologique détaillée de la France (1 : 80000) Feuille 28, St. Lô (2^e Ed.) 1926.

of these localities see Text-fig. 1.) This material was augmented by some samples given by Dr. F. Schmid (Hannover) and Polyzoa from Fresville presented by Dr. P. Marie (Paris). It is interesting that many different and new forms not mentioned by d'Orbigny were found at these localities, and by contrast, a large number of d'Orbigny's species could not be found again. Perhaps there are some horizons with a different fauna, and the beds of Sainte Colombe and Néhou may belong to such levels, whose exposures are abandoned today, or the different localities represent heterogeneous ecologic biotopes.

The Polyzoan fauna of this region is the most important one in the northern area and its knowledge is fundamental to our knowledge of the Maastrichtian Polyzoa. With the exception of the inadequate revision of the Cretaceous Polyzoa of d'Orbigny as a whole, which was undertaken by Pergens (1889) and by Canu (1900), nobody has concerned himself with the Polyzoan fauna of the Cotentin for 110 years. An up-to-date revision of this fauna is therefore an urgent task, but it cannot be undertaken without a re-study of d'Orbigny's types which are preserved in the Musée d'Histoire naturelle in Paris.

The most obvious obstacle for a successful revision is the fact that many of d'Orbigny's type specimens are missing, or, if specimens are present, it is often impossible to say with certainty whether they are true "types" or not. On the other hand many of the drawings do not agree well with the originals; they may be stylized, restored or improved and consequently it is often rather difficult to give a satisfactory identification of d'Orbigny's species (see Canu 1900 : 335). His omission to specify the exact locality of the figured specimen in cases when there is more than one such locality, increases the difficulty of identifying the types. There are about 300 photographs of d'Orbigny's polyzoan types of the Paléontologie Française in the author's collection, and this stock, together with a rich collection of French Cretaceous Polyzoa, are the basis for the following discussion.

The proofs for a Cotentin origin for Gregory's "Jurassic Cheilostomata" are:

1. The matrix of sediment adhering to Gregory's originals is identical to that of the above-listed Maastrichtian localities of Cotentin. The matrix detached from block D.181 with *Onychocella piriformis* Goldfuss has yielded two specimens (BB.42981-82) of the characteristic fossil *Thecidea papillata* V. Schlottheim (pl. 1, figs. 9-10) and it is evident that it has been collected from the so-called "Craie à Thécidées" of the Cotentin.

2. The objection that this brachiopod is also common at Maastricht and in Belgium in a similar facies is weakened by the fact that the accompanying fauna in this block, consisting of thirty-one species of Polyzoa, contains some species which are confined to the Cotentin fauna and have never been found in Holland and Belgium, although indeed both strata have many species in common. Examples of species not known from these countries are: *Multicrescis laxata* d'Orbigny, *Membranipora unipora* Marsson, *Stamenocella* cf. *marginata* (d'Orbigny), *Castanopora jurassica* (Gregory), *Onychocella bellona* (d'Orbigny), *Onychocella* cf. *cephala* d'Orbigny, *Onychocellaria caecilia* sp., *Semiescharinella complanata* d'Orbigny, *Lunulites* sp., *Rosseliana thomasi* n. sp., *Fruitionella fertilis* n. sp. and others.

3. A Cotentin origin is further suggested by another Cretaceous Polyzoan in the museum collection which is embedded in a typical sample of " Craie à Thécidées ". It is a large specimen of a *Reticrisina*, determined as the Jurassic "*Reticulipora dianthus* (Blainville) " (B.4569 Old collection) and labelled " Bathonian Fresville ". This example gives a good idea of how the error could have arisen: Bathonian rocks being absent near Fresville, Cretaceous Polyzoa were mistaken for Bathonian fossils. Gregory's " Jurassic Cheilostomata " both belong to the Tesson-Collection, which according to Gregory's Catalogue contains many Bathonian Polyzoa from the famous locality of Ranville (Calvados).

The two localities are about 100 km. apart, and it is probable that the labels were confused or that the Cretaceous Polyzoan limestone was mistaken for the not dissimilar Coral and Polyzoan-limestone (" Calcaire à polypiers ") of the Bathonian.

The Tesson-Collection to which Gregory's types belong was acquired in 1857 (Gregory 1896 : 35) and the fossils were probably collected many years ago at a time when geological mapping of this region was still in its infancy.

It is not impossible that Gregory's types both came from Fresville like the *Reticrisina* mentioned above. The rock matrix of D. 181 is very like that of the " Craie à Thécidées " of Fresville, but as Dr. Dighton Thomas informed me, that from Chef du Pont is even closer in appearance. But such lithological differences may occur in the same sequence, and are of no great importance.

At least one other possible explanation of this error should be mentioned. Between the Maastrichtian outcrops of Sainte Colombe and Rue Tourville is the village Rauville-la-Place (see Text-fig. 1). Possibly a label " Rauville " was misunderstood for " Ranville ", Calvados.

It must be reckoned that errors like these are more common in old collections, and it may be recalled that a considerable number of Reuss' " Cenomanian Polyzoa of Saxony " came from the Vincentown Limesand in New Jersey (U.S.A.), of Danopaleocene age (Voigt 1942). Another mistake is the supposedly new "*Polyphyma bulbosa* " Hamm (1881) from Maastricht which is a Hauterivian form from northern Germany, and which was described in 1839 by Roemer as *Alveolites heteropora* (Voigt 1953 : 57). Certain suspicious anachronisms of phylogenetic level may be explained in this manner as has been shown by the present author with some of Reuss' types.

4. I have collected much material of Bathonian Polyzoa at the classic locality of Ranville (Calvados), but I have never found any trace of Cheilostomata. The objection, that the Cheilostomata may originate in Jurassic times cannot be contested; but we have no remains of them earlier than the Lower Cretaceous. It is true that in the last decade several important groups of fossils have been proved to be older than was formerly assumed. Today we know of Cambrian bivalves, Carboniferous belemnites, Triassic frogs, and these examples could be augmented. It is possible that Jurassic Cheilostomata may be found one day. But in such a case we should expect primitive forms like Membranimorphs as are found in the lower Cretaceous and not highly developed forms like *Onychocella*, or highly specialized forms like the Cribrimorph *Castanopora*.

Lower Cretaceous Cheilostomata are of the greatest phylogenetic interest, and all

forms described to date are rare. Most of them are Albian and the oldest is recorded from the Neocomian. Their number is so small that they can be listed in a few lines:

1. *Membranipora neocomiensis* d'Orbigny 1853,
Neocomian, Saint-Sauveur, Yonne, France. The only specimen was too bad to be figured by d'Orbigny. It must be regarded as a nomen nudum.
2. "*Membranipora*" *constricta* d'Orbigny 1853,
Aptian, Les Croutes (Yonne).
Remarks: I have photographed the supposed "type" of this species (pl. 7, fig. 8). It is without doubt a "*Membranipora*" s.l., but it does not correspond with the original figure.
3. *Rhammatopora* (?) *johnstoniana* Mantell 1844,
Aptian, Lower Greensand, Shanklin-Sand, Kent.
4. *Rhammatopora gaultina* Vine 1890, with his synonyms *Rhammatopora vinei* Lang and *Rhammatopora pembrookiae* Lang (c.f. Thomas & Larwood 1960) Albian-Cenomanian, England.
5. *Charixa vennensis* Lang 1915, Albian, Dorset.
6. *Pyripora texana* Thomas & Larwood 1956, Albian, Texas (U.S.A.).
7. *Wilbertopora mutabilis* Cheetham 1954, Albian, Texas (U.S.A.).

Vine (1890) mentioned *Membranipora fragilis* d'Orbigny, *Membranipora* ? *obliqua* d'Orbigny, *Membranipora elliptica* v. Hagenow and *Hippothoa simplex* d'Orbigny from the Red Chalk of Hunstanton. The identification of these forms must be revised, but nevertheless all the named species are primitive encrusting membraniporphs of the Division Malacostega, suborder Anasca, and half of them are mono- or oligoserial, and lack either ovicells or avicularia as we must theoretically presume if our ideas about the evolution of the early Cheilostomata are correct. They are followed in the Cenomanian by the first primitive Cribrimorphs and Coilostega with the families of Onychocellidae and Microporidae. Therefore it is hard to understand why Canu & Bassler (1920 : 318) stated that following the Membraniporae, the Acroporidae Canu 1913 (= Porinidae d'Orbigny 1852) of the suborder Asco-phora are the most ancient Cheilostome fossils. The main evolution of this family is in the later Upper Cretaceous, and the only described species of *Porina* from the Cenomanian is *P. cenomana* Lecointre (1912) whose origin and inner structure needs revising.

V. PALAEOZOIC CHEILOSTOMATA?

In this connection the question of the systematic position of the north American families Worthenoporidae Ulrich 1893 (Carboniferous) and Palescharidae Miller 1889 (Ordovician-Devonian) cannot be neglected. These were established for the single genera *Worthenopora* Ulrich 1889 and *Paleschara* Hall 1874 which resemble Cheilostome Polyzoa in some features. Ulrich (1890) stated that the affinities of that genus are nearer to the Membraniporidae than any other and that his present views would admit it being placed in the Cheilostomata. Nickles & Bassler (1900) regarded both families without any restriction as Cheilostomata. This classification was followed by many authors, but in recent times this opinion seems to have been

abandoned. Bassler (1953) has placed them among the Cryptostomata, but considers *Worthenopora* "may belong among cheilostomes".

Worthenopora, indeed, has the outward aspect of a Cheilostome with its triangular or semielliptical apertures, with posterior raised margin and spine bases. *Paleschara* with its simple short polygonal zooecia is like a *Membranipora* which possesses completely opened opesiaes without any trace of a gymnocyst.

Dr. Dighton Thomas has kindly lent me some specimens of both genera from the museum collection. Although there is no space here to go into details, further studies of this problem are intended. I have got the impression that they cannot be attributed to the Cheilostomata. *Paleschara* must be regarded as a very primitive Cryptostome, and *Worthenopora*, in contrast, as a specialized one. The latter has reached a level of evolution which reminds one of certain Cheilostomata. It has not been found in beds younger than Mississippian, and there are no intermediate forms between it and the Cretaceous Cheilostomata. Consequently it seems to be impossible to regard it as an ancestor of the true earliest membraniform Cheilostomata of the Lower Cretaceous.

Paleschara, with its network of rather simple polygonal zooecia, may perhaps be primitive enough to give rise to Cheilostomata-like forms. But it could be better regarded as a cryptostomatous form corresponding to a membraniform level of primitive Cheilostomata.

We have no palaeontological evidence for a descent of the Cheilostomata from the Cryptostomata or from the Ctenostomata. As Borg (1930 : 54) and Cori (1941) regard the Ctenostomata as emanating from primitive Cheilostomata, it must be emphasized that the Ctenostomata are the older group, represented by fossils from the Ordovician onwards and that there is no possibility of deriving the Ctenostomata from the Cheilostomata. Silén (1942) regards the Cheilostomata and the Ctenostomata as closely allied ("Cheilo-Ctenostomata") and believes that both have common ancestors.

Silén has established an interesting theory about the origin of the Cheilostomata from hypothetical primitive forms like the recent *Labriostomella* which he calls Protocheilostomata. These have erect zoaria with frontal budding and other primitive features, and it would mean that the encrusting growth of many Cheilostomata and the lateral budding as existing in all other Cheilostomata, are secondary. It should be emphasized that the oldest known Cheilostomata from the Lower Cretaceous do not show this primitive character. All are encrusting, and they must already have passed the evolutionary level of the "Protocheilostomata", which according to Silén were feebly or not at all calcified. If this is admitted, there remains no possibility of regarding *Worthenopora* or *Paleschara* as early Cheilostomata of the Palaeozoic.

VI. THE ACCOMPANYING FAUNA OF THE MATRIX OF GREGORY'S " JURASSIC CHEILOSTOMATA "

It is satisfactory that in the matrix of Gregory's "Jurassic Cheilostomata" are enclosed other Bryozoa which were overlooked by Gregory. In block D.180, containing *Castanopora jurassica*, *Multicrescis laxata* d'Orbigny, *Rosseliana thomasi* n. sp. and *Pliophoea* sp. could also be observed.

I am much indebted to Dr. Dighton Thomas for his permission to remove about 2 cm.³ of the matrix of block D.181 with *Onychocella bathonica*. This piece was cracked under a press and the washing of the residue has yielded a fauna of thirty-three species of Polyzoa and one Brachiopod. This fauna is described in detail in the following part of this paper. Most of the treated specimens are figured although the state of preservation is rather poor because the hard rock is unfavourable for clean preparation. All specimens are somewhat damaged, or rolled and, unfortunately, recrystallized or covered with minute calcite crystals as is often observed in the Cotentin material, and it is nearly impossible to stain them with colour. This explains any mediocre photos. In many cases figures of comparable specimens of the same species from the Cotentin are given for comparison. If they do not always present exactly the same picture as the specimens from the original French localities, this is because there often exists a great variability in size or growth-stage, and in preservation, and that the identification is based upon a vast quantity of material. It is surprising that in only 2 cm.³ of rock from D.181 some small fragments of new species were found, although these have long been known to the author from the Maastrichtian of the Cotentin. The opportunity is taken here to describe them. But it should not be forgotten that this small fauna from only a few cm.³ matrix must represent a very small part of the rich Polyzoan fauna of the Cotentin Maastrichtian, and that its composition is purely accidental.

The list given in table 1, p. 41, contains thirty-three Polyzoan species of which twenty-four are Cheilostomata. It is not complete because in some cases a complete identification could not be made, and for a few forms no identification was possible. Excepting *Pliophloea* sp. all forms have been found by the author in the Maastrichtian of the Cotentin. Twenty-six species were found at Chef du Pont, eighteen at Port Filiolet and nine at Fresville. But it should be taken into account that the investigated material is too poor for important deductions. Many species very common at all Cotentin localities are not represented, and others are new for the Cotentin. The affinities with the classic locality of Maastricht are proved by fourteen species but this figure may be too large because several forms of both regions may be identical. Von Hagenow's types from Maastricht having been lost during the second world war, it is not yet possible to decide this question with certainty.

I. POLYZOA

A. CYCLOSTOMATA

Genus *BERENICEA* Lamouroux 1821

1. *Berenicea* sp.

One small incomplete zoarium which is indeterminable, encrusts *Reteporidea lichenoides* Goldfuss.

SPECIMENS. A minute incomplete zoarium encrusting *Reteporidea lichenoides* Goldfuss (= D.49569).

Genus *ENTALOPHORA* Lamouroux 18212. *Entalophora benedeniana* (von Hagenow)

- 1851 *Pustulopora benedeniana* von Hagenow: 17, pl. 1, fig. 6.
 1899 *Entalophora madreporacea* Goldfuss var. *benedeni* von Hagenow; Gregory: 239.
 1964 *Entalophora benedeniana* (von Hagenow) Voigt: 422, pl. 1, figs. 1-7.

One small fragment embedded in matrix has been referred to this well-known species from Maastricht which is represented in the author's collection from the Maastrichtian of Chef du Pont (Manche). For morphological details and ovicells see Voigt (1964).

SPECIMENS. D.49560. One poorly preserved fragment in matrix from D.181. Upper Maastrichtian, Cotentin, Manche, France.

Genus *IDMIDRONEA* Canu & Bassler 19203. *Idmidronea macilenta* (von Hagenow)

- 1851 *Idmonea macilenta* von Hagenow: 29, pl. 2, fig. 4.
 ?1851 *Idmonea ramosa* d'Orbigny: 736, pl. 611, figs. 11-15.
 1899 *Relecava ramosa* (d'Orbigny) Gregory: 192, pro parte.
 1951 *Idmidronea macilenta* Voigt: 38, pl. 4, figs. 14-17.

One small distal fragment of this abundant species of the Upper Maastrichtian belongs to *I. macilenta*. These thin distal branches do not have the numerous firmatopores which are well developed on the reverse side of the broader and older stems. Therefore they are very similar to *Idmonea (Tubigera) antiqua* Defrance (d'Orbigny 1853: 722, pl. 613, figs. 11-15, figured under the name of *Stichopora regularis* d'Orbigny). *Idmonea disticha* Goldfuss (sensu von Hagenow 1851: 30, pl. 2, fig. 8) may be mistaken for this form also, but always it is not so flat as the distal ends of *Idmidronea macilenta*. The species cited by d'Orbigny from Sainte-Colombe under the latter name may be *Idmonea macilenta*.

If this species is con-specific with *Idmonea ramosa* d'Orbigny, the latter name has priority and must be preferred. It is represented at Fresville (Cotentin, Manche).

STRATIGRAPHICAL RANGE. Upper Maastrichtian.

SPECIMENS. D.49561. A worn fragment from matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49843. A fragment, upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. E. Voigt Collection.

Genus *HETEROCRISINA* Gabb & Horn 1860, em. Voigt 19644. *Heterocrisina communis* (d'Orbigny)

- 1853 *Idmonea communis* d'Orbigny: 745, pl. 750, figs. 6-10.
 1887 *Idmonea pseudodisticha* (non von Hagenow) Marsson: 28, pl. 2, fig. 8.
 1860 *Heterocrisina abbottii* Gabb & Horn: 404, pl. 69, figs. 45-47.
 1899 *Relecava abbottii* (Gabb & Horn) Gregory: 205.
 non 1907 *Idmonea abbottii* (Gabb & Horn) Ulrich & Bassler: 321, pl. 22, figs. 3-4.
 1964 *Heterocrisina communis* (d'Orbigny) Voigt: 432 pl. 3, figs. 1-10.

Two small worn fragments belong to this species, which is very distinctive because of its large frontal ovicell, although it has often been mistaken for other species. For further information about its generic position and morphological details see Voigt (1964).

This form is common at all Maastrichtian localities in the Cotentin (Fresville, Port Filiolet and Chef du Pont).

STRATIGRAPHICAL RANGE. Campanian-Maastrichtian.

SPECIMENS. D.49562-63. From matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

Genus *CRISISINA* d'Orbigny 1847

5. *Crisisina carinata* (Roemer)

(Pl. 1, figs. 4-5)

1840 *Idmonea carinata* Roemer: 21, pl. 5, fig. 20.

1964 *Crisisina carinata* (Roemer) Voigt: 429, pl. 4, figs. 1-7. (See full references.)

Three worn fragments belong to this very common and widespread species of the Upper Cretaceous. The synonymy is very confused—see Voigt (1964)—where all known synonymies are given and the generic classification is discussed.

Very abundant at all Maastrichtian Cotentin localities.

STRATIGRAPHICAL RANGE. Cenomanian-Paleocene.

SPECIMENS. D.49564-66. From matrix of D.181. Upper Maastrichtian, Cotentin, France.

D.49567. A fragment for comparison with D.49566. Upper Maastrichtian, Port Filiolet, Cotentin, Manche, France, Voigt Collection.

Genus *OSCULIPORA* d'Orbigny 1847

6. *Osculipora truncata* (Goldfuss)

1826 *Retepora truncata* Goldfuss: 28, pl. 9, fig. 14.

1851 *Truncatula truncata* (Goldfuss) v. Hagenow: 35, pl. 3, fig. 2.

1851 *Truncatula tetrasticha* von Hagenow: 34, pl. 3, fig. 3.

1909 *Osculipora truncata* (Goldfuss) Gregory: 58.

1922 *Osculipora truncata* (Goldfuss) Canu & Bassler: 57, pl. 23, figs. 1-6.

One small worn fragment may be referred to *O. truncata*; it is in the condition of *Truncatula tetrasticha* von Hagenow, which represents highly worn branches of *O. truncata* (Goldfuss.)

Further investigations are necessary to check whether the older citations of this form from the Cenomanian by Reuss (1872) are correct. In the author's collection from Chef du Pont, Port Filiolet and Fresville are numerous fragments of this species, which was not recorded by d'Orbigny from any of his Cotentin localities.

STRATIGRAPHICAL RANGE. Cenomanian (?) to Maastrichtian.

SPECIMENS. D.49568. A very poorly preserved worn fragment from the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

Genus *RETEPORIDEA* d'Orbigny 1849

7. *Reteporidaea lichenoides* (Goldfuss)

1826 *Retepora lichenoides* Goldfuss: 29, pl. 9, figs. 13a-b.

1851 *Idmonea lichenoides* (Goldfuss) von Hagenow: 28, pl. 2, fig. 6.

1899 *Retecava lichenoides* (Goldfuss) Gregory: 194, fig. 16, p. 195.

One very poor fragment which is encrusted by a small young *Berenicea*, has been recognized as this species which is very abundant in the Upper Maastrichtian. It is represented in the author's collection from Port Filiolet by some specimens. It has not previously been recorded from the Cotentin Maastrichtian.

STRATIGRAPHICAL RANGE. Maastrichtian.

SPECIMENS. D.49569. A small worn fragment with an encrusting *Berenicea* from the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

Genus *PETALOPORA* Lonsdale 1850

8. *Petalopora* sp.

(Pl. 1, figs. 1-3)

There are a few fragments of a badly preserved *Petalopora* which are conspecific with similar specimens from Chef du Pont (pl. 1, fig. 2). Their identification involves some difficulties because it is impossible to identify them from published figures. They are allied to *Heteropora reticulata* Marsson (1887: 26, pl. 2, fig. 4) in the size of the branches and diameter of the apertures (about 0.14-0.15 mm.), but the mesopores are much less conspicuous, and on the figured fragment (pl. 1, fig. 1) they look a little like longitudinally-oriented lines which are straight or sinuously bent and interspersed between fine ribs. On the specimen from Chef du Pont the mesopores are larger and they show a more longitudinally-oriented inconspicuous network (pl. 1, fig. 3). I have no doubt that these three specimens are conspecific in spite of this difference but I dare not identify them with any known species.

SPECIMENS. D.49570-72. Three small worn fragments from the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49573. A larger fragment from the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49574. A larger fragment. Upper Maastrichtian, Port Filiolet, Cotentin, Manche, France. Voigt Collection. One branched fragment. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Voigt Collection, Hamburg, Nr. 3969.

Genus *MULTICRESCIS* d'Orbigny 1854

9. *Multicrescis laxata* d'Orbigny

(Pl. 1, figs. 6-8)

1854 *Multicrescis laxata* d'Orbigny: 1077, pl. 800, figs. 10-11.

HOLOTYPE. Upper Maastrichtian, Sainte Colombe, Cotentin, Manche, France. d'Orbigny Collection, Paris, Musée d'Histoire Naturelle Nr. 8416.

There is a fragment of a "heteropodid" Polyzoan with an encrusting colony of *Rosseliana thomasi* n. sp. embedded in the matrix of *Castanopora jurassica* Gregory (D. 181). It cannot be distinguished from d'Orbigny's type specimen of *Multicrescis laxata*, whose apertures and the mesopores are exactly the same. Unfortunately there are no other specimens of this species in d'Orbigny's collection which would allow confirmation of the inner structures by sections. Specimens from Chef du Pont (Manche), which seem to be conspecific with d'Orbigny's species have a median lamella like *Grammascosoecia* Canu & Bassler 1922. Pergens (1889 : 373) and Canu & Bassler (1922 : 119) have included this species in the synonymy of *Grammascosoecia dichotoma* (Goldfuss) from Maastricht (see von Hagenow 1851 : 47, pl. 5, fig. 15). This might be correct; some specimens from Fresville can hardly be distinguished from the Maastricht species. On the other hand there are some fifty fragments from Fresville, and none show the characteristic pattern of small regular smooth quadrangles which grow from the calcified mesopores (cf. von Hagenow's fig. 151 and Voigt 1951 pl. 4, fig. 1) and which can be observed in the majority of the Maastricht specimens. Therefore I still hesitate to unite it with *Grammascosoecia dichotoma* (Goldfuss).

D'Orbigny attributed his species to his genus *Multicrescis* which is multilamellar. But this is not the case in *M. laxata*, although d'Orbigny noted two layers in his type-specimen from Sainte-Colombe, which is a basal fragment (pl. 1, figs. 7-8). It is well known that the basal stems often develop more than one layer of zoecia, and therefore there is no reason to place this form in the genus *Multicrescis*. Many specimens from Fresville have radiating rows of peristomes as in *Multicavea*, which can also be observed in *Grammascosoecia dichotoma* (Goldfuss). But the ovicell of the Cotentin form has not yet been discovered. Therefore I prefer to leave this form provisionally under the name given by d'Orbigny.

It should be noted that the median lamella in *Grammascosoecia dichotoma* (Goldfuss) is not constant. It is lacking in many specimens from Maastricht, and there is no reason to assume a different species.

STRATIGRAPHICAL RANGE. Upper Maastrichtian.

SPECIMENS. D. 49575. A worn fragment with encrusting *Rosseliana thomasi* n. sp. embedded in matrix of *Castanopora jurassica* (Gregory) (D. 180). Upper Maastrichtian, Cotentin, Manche, France. Labelled erroneously by Gregory as "Bathonian, Ranville, Calvados".

B. CHEILOSTOMATA

MEMBRANIPORA Blainville 1830 (sensu lato)

10. "*Membranipora*" *unipora* (Marsson)

(Pl. 2, figs. 7-8)

1852 *Flustrella simplex* d'Orbigny: 293, pl. 699, figs. 14-16.

1887 *Biflustra unipora* Marsson: 52.

1929 *Membranipora genucia* Brydone: 37, pl. 13, figs. 10-11.

1930 *Membranipora unipora* (Marsson): Voigt 420, pl. 4, fig. 5.

1925 *Membranipora unipora* (Marsson): Levinsen 329, pl. 2, fig. 22.

HOLOTYPE. Upper Maastrichtian, Néhou, Cotentin, Manche, France. d'Orbigny Collection, Paris. Musée d'Histoire Naturelle Nr. 8130.

One unilaminar specimen embedded in matrix, showing some zooecia with the characteristic avicularium on the gymnocyst below the opesia and the narrow helmet-shaped hyperstomial ovicell, agrees very well with d'Orbigny's type from Néhou (pl. 2, fig. 8) and another well preserved specimen from the Maastrichtian of Port Filiolet (Manche). The zoarial length is from 0.80–1.20 mm. The spines of the well raised margin of the opesia, which is 0.45–0.50 mm. long, number about twenty, but they are inconspicuous and often hidden by recrystallization of calcite. The zooecia and the opesiae of my specimen of this species from Port Filiolet are a little larger than those of the Museum-specimen but this lies within the range of variation of this form. *Membranipora genucia*, described by Brydone from the upper Campanian of Meudon near Paris, is a synonym as shown by comparison with Cotentin and Rügen specimens with those from Meudon.

Marsson who translated this species from *Flustrella* to *Biflustra*, has changed the species name *simplex* to *unipora* because there existed already a recent *Biflustra simplex* d'Orbigny 1839. Otherwise another Cretaceous *Membranipora simplex* d'Orbigny exists too. It is clear that the placing of this species in "*Membranipora*" is only provisional; a revision of the Cretaceous Membraniporae might put it in another genus.

STRATIGRAPHICAL RANGE. Upper Campanian-Maastrichtian.

SPECIMENS. D.49576. Fragment with ovicelled zooecia from the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

Genus **AMPHIBLESTRELLA** Prud'homme 1960

II. *Amphiblestrella elegans* (von Hagenow)

(Pl. 4, figs. 1–3)

1851 *Siphonella elegans* von Hagenow: 84, pl. 6, fig. 7.

1851 *Flustrella baculina* d'Orbigny: 291, pl. 699, figs. 4–6.

1930 *Amphiblestrum elegans* (von Hagenow) Voigt: 448, pl. 13, figs. 13–16.

1960 *Amphiblestrella elegans* (von Hagenow): Prud'homme: 949.

1962 *Amphiblestrum elegans* (von Hagenow) Berthelsen: 100, pl. 9, figs. 1–5.

There is only one small fragment which is 1.7 mm. long and shows eight rows of zooecia; normally there are ten to sixteen. The zoarial dimensions are smaller than those of specimens from the type-locality of Maastricht, and from the Cotentin, where this species is very common. The axial canal of the hollow zoaria, clearly visible in the thicker zoaria, is much reduced in the slender branches, and may disappear almost completely as shown in d'Orbigny's type specimen of his *Flustrella baculina* (pl. 4, fig. 2) from Néhou. The zooecia from Danian material are mostly longer than those from the Maastrichtian (about 0.7 mm. instead of 0.6 mm.). The size of the opesiae is very variable in this species. Canu (1900) in his revision of

d'Orbigny (1851-54) has incorrectly regarded this species as a synonym of *Flustrella irregularis* d'Orbigny.

In the Cotentin localities this species is represented from Fresville and Chef du Pont and by d'Orbigny's type specimen of *Flustrella baculina* from Néhou.

STRATIGRAPHICAL RANGE. Maastrichtian-Danian.

SPECIMENS. D.49577. A worn fragment from matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49578. A well preserved branched fragment. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Voigt Collection.

Type-specimen of *Flustrella baculina* d'Orbigny. Upper Maastrichtian Néhou, Cotentin, Manche, France. In d'Orbigny Collection, Paris, Musée d'Histoire Naturelle Nr. 8127.

Genus *RADULOPORA* nov.

DERIVATIO NOMINIS. Derived from the species-name of *Biflustra radula* Marsson 1887.

DIAGNOSIS. Zoarium bilaminar, dichotomously branched and probably radicelled at the base. Zooecia dimorphic, the marginal zooecia of the acute edges of the branches being larger, and having larger opesia than the normal zooecia. Cryptocyst well developed, finely granulated; opesia small with straight proximal rim and occasionally developed lip. Distal interzooecial asymmetrical vibracula above the opesia with long elliptical opening and a small thornlike process going out from the left or right inner margin. Ovicells inconspicuous exteriorly, deeply immersed, endozooecial.

Type species: *Biflustra radula* Marsson 1887, Lower Maastrichtian Rügen (Germany).

REMARKS. This new genus comprises three characteristic species in the Maastrichtian, which cannot be attributed to any other genus hitherto known. *Biflustra radula* Marsson was assigned incorrectly to *Amphiblestrum* by Voigt (1930). It differs from *Amphiblestrum* not only in its bilaminar and apparently radicelled zoarium with dimorphic zooecia and semicircular opesia in which a proximal lip is originally developed, but also by its avicularian-like vibraculum. This has no pivot for the articulation of the mandibula as in true avicularia, but asymmetrical curved thorn-like processes on the inner left or right edge of the vibracula (Text-fig. 2) and an ellipsoidal cavity in the proximal part adapted for the motion of the seta of the vibraculum. These structures are very well shown in the type-species, *R. radula* (Marsson) (pl. 3, figs. 11-12), while they are indicated in *R. minor* only in some better preserved specimens.

Owing to the loss of the Marsson Collection during the last war, a neotype for *R. radula* Marsson should be erected. The specimen of *Biflustra radula* figured here could represent a good neotype, but it was collected from a chalk block in glacial drift and therefore a topotype from the Lower Maastrichtian of Rügen would be preferred.

It is difficult to decide if this genus should be regarded as belonging to the Mala-

costega or Coilostega. The cryptocyst is strongly calcified and the opesia is so small that the Malacostega level has probably been exceeded. Opesiules are absent as in many Coilostega. Nevertheless Marsson described it as *Biflustra*, and perhaps he was right to assign it to the Membranimorphs, although there are many intermediate forms between these two groups. This genus seems to be rather isolated and it is difficult to attribute it to one particular family of the Malacostega.

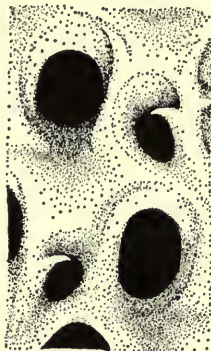


FIG. 2. *Radulopora radula* (Marsson). Some zoecia and vibracularia. $\times 60$.

12. *Radulopora minor* sp. n.

(Pl. 3, figs. 6-10)

Holotype Upper Maastrichtian, St. Pietersberg near Maastricht (Netherlands). D.49844. Voigt Collection.

DERIVATIO NOMINIS. The name refers to the smaller zoecial dimensions in contrast to the type-species *R. radula* (Marsson) (pl. 3, figs. 11-12).

DIAGNOSIS. *Radulopora* with slender dichotomous branches 0.7-1.2 mm. wide, consisting of about three to seven alternating transverse rows of zoecia about 0.5-0.6 mm. long. The edges of the zoarium are formed by the larger marginal zoecia: other zoecia not clearly distinct at their margins, elongate and pyriform with distal raised margin and a well developed cryptocyst deeply immersed proximally. Opesiae rounded quadrangular or high-semicircular rounded distally and truncated proximally, showing in some specimens a well developed proximal lip. Distal vibracula small, the peak turned obliquely downwards but symmetrically oriented outwards from the median line toward the edges of the branches. Ovicells form inconspicuous slight swellings above the opesiae (pl. 3, fig. 9).

DESCRIPTION. The bilaminar fronds have narrow cylindrical or prismatic basal rods which are pointed toward their proximal ends and suggest an articulated basal attachment of the zoarium. The zoarial and opesial dimensions are smaller in these proximal parts of the zoarium than in the more distal branches. The shape of the opesia varies from nearly semi-circular to high-oval, trapezoidal or oval: if it is oval it is narrowed proximally but it is never circular. The straight proximal edge of the opesia is deeply immersed in old zoecia and may disappear. The distinct

proximal lip observed regularly in some specimens has its origin from this straight proximal edge. The opesia occupies about one quarter to one fifth of the length of the zoecium. The cryptocyst is highly calcified and often appears in the proximal part. The marginal zoecia appears to be larger than they actually are because they are not narrowed in their proximal part, and the opesiae are always distinctly larger than in the other zoecia, although there may be transitions between the size of the opesiae of the normal and those of the marginal zoecia. The ovicelled zoecia never have vibracula. The ovicells are very flat swellings above the opesiae. If their roof is broken away a large deep hollow is revealed showing that the ovicell is deeply immersed although it must be regarded as endozoecial.

A minute fragment of eight zoecia belongs to this species which corresponds very well with the abundant material of the author's collection from the Cotentin localities and from Maastricht.

MEASUREMENTS.

Lz (= Distance between the opesia): 0.50-0.67 mm.

ho = 0.10-0.12 mm. } normal zoecia.
lo = 0.075-0.12 mm. }

ho = 0.14-0.17 mm. } marginal zoecia.
lo = 0.15-0.16 mm. }

STRATIGRAPHICAL RANGE. Upper Maastrichtian.

SPECIMENS. D.49579. A small worn fragment. From matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49580-81. Two fragments. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Voigt Collection.

D.49582. Fragment with ovicelled zoecia. Upper Maastrichtian, Cotentin, Manche, France. Voigt Collection.

Genus *HAGENOWINELLA* Canu 1900

13. *Hagenowinella* cf. *incrassata* (d'Orbigny)

(Pl. 2, figs. 1-3)

1853 *Flustrellaria incrassata* d'Orbigny: 527, pl. 726, figs. 5-8.

A large unilaminar fragment consisting of more than twenty zoecia may belong to this species, although the opesiae are oval and not so broad and truncated as in d'Orbigny's type-specimen from Sainte-Colombe (Manche). A fragment of this form collected by the author near Chef du Pont (Manche), shows, however, that the shape of the opesiae can vary considerably and that in certain parts of the zoarium the opesiae are fairly oval as in D.49583, in which two zoecia have the cryptocyst broken giving the false appearance of avicularia. The hyperstomial ovicells shown on the specimen from Chef du Pont are broad and low. The horse shoe-like lamella in the interior of the zoecia seems to be hidden by a fine calcitic crust, but it is indicated in pl. 2, figs. 2-3, by two small knob-like processes at the inner margin of the opesia.

SPECIMENS. D.49583. A small fragment of zoarium, embedded in matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49845. Fragment of zoarium. Upper Maastrichtian, Fresville, Cotentin, Manche, France. Voigt Collection. Fragment with ovicelled zooecia. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Voigt Collection, Hamburg, Nr. 3909.

STRATIGRAPHICAL RANGE. Upper Maastrichtian.

Genus *BACTRELLARIA* Marsson 1887

14. *Bactrellaria rugica* Marsson

(Pl. 2, figs. 9-14)

1887 *Bactrellaria rugica* Marsson 59, pl. 5, fig. 18.

1930 *Bactrellaria rugica* Marsson; Voigt: 444, pl. 12, figs. 25-26.

The species is represented by one very poor fragment showing four zooecia of the frontal face with worn avicularia forming cavities between the opesiae. Although the specimen is very small and worn, the species is so characteristic that there is no doubt about the identification. It has been found by the author at Maastricht and Port Filiolet (Manche) where it is rare. The frontal avicularium below the opesia is, if well preserved, rather prominent, elongate beak-like and is proximally oriented with a raised spatulate peak. Marsson's figure showing only a round pore is inadequate, but he makes mention of the tube-like avicularia which occasionally occur on the lateral edges of the zoaria. The frontal avicularium below the opesia, is, if present and well preserved, rather prominent, tube-like, elongate and proximally oriented. Its beak is dilated and spatulate but is mostly broken away or damaged. It is rather well preserved on a specimen from an Upper Maastrichtian chalk-bearing erratic flint-boulder found in the gravel-pit of Wulmstorf near Harburg (pl. 2, fig. 13). If the dilated spatulate avicularian beak is destroyed there remains an oval ring or a scar like the ones in many specimens of the Cotentin (pl. 2, figs. 9 and 12). The small pit on Marsson's figure, however, is not the cicatrix of a destroyed avicularium, but corresponds to the spot where the avicularium is usually developed. Three pairs of oral spines are present in well preserved specimens. The ovicells are hyperstomial. Many fragments of the band-like zoaria from the Cotentin localities have four to six rows of zooecia instead of three; their diameter varies between 0.7-2.0 mm. The length of the zooecia is between 0.6-0.8 mm., that of the opesia c. 0.35 mm. In addition to the band-like specimens there occur, at Maastricht, prismatic vincularian rods with five or more rows of zooecia showing absolutely the same features and size of zooecia, avicularia and ovicells. They are very like *Pithodella* and it is possible that they represent another mode of growth of the same species. *Eschara gaimardi* von Hagenow (1851: 82, pl. 12, fig. 10) is thought to be an *Eschara-like* stem development of this genus.

STRATIGRAPHICAL RANGE. Maastrichtian.

SPECIMENS. D.49584. A small worn fragment. From matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49585. A well preserved fragment. Upper Maastrichtian, Port Filiolet, Cotentin, Manche, France. E. Voigt Collection. A worn fragment. Upper Maastrichtian, Port Filiolet, Cotentin, Manche, France. Voigt Collection, Hamburg Nr. 3914.

A well preserved fragment. Upper Maastrichtian Chalk from Flint-boulder in Pleistocene Drift. Wulmstorf near Harburg-Hamburg, Germany. Voigt Collection Nr. 4146.

Genus *STAMENOCELLA* Canu & Bassler 1917

15. *Stamenocella marginata* (d'Orbigny)

(Pl. 3, figs. 1-5)

1852 *Flustrella marginata* d'Orbigny: 295, pl. 700, figs. 7-9.

1852 *Flustrella convexa* d'Orbigny: 290, pl. 699, figs. 1-3.

1852 *Biflustra tessellata* d'Orbigny: 271, pl. 694, figs. 7-9.

HOLOTYPE. A small fragment of *Flustrella marginata* d'Orbigny. Upper Maastrichtian, Sainte Colombe, Cotentin, Manche, France. In d'Orbigny Collection, Paris, Musée d'Histoire Naturelle, Nr. 8134.

A worn fragment of this species embedded in the matrix of *Onychocella bathonica* Gregory (D. 181) agrees in all essential characteristics with the two specimens which were described by d'Orbigny as *Flustrella marginata* from Sainte-Colombe and *Biflustra tessellata* from Néhou, and which are figured here for comparison. The latter is a worn specimen of *Stamenocella marginata* showing traces of ovicells and represents the same stage of preservation as figs. 3 and 8 of pl. 31 of Canu & Bassler (1920) where the ovicells and the avicularia of *Stamenocella mediaviculifera* and *Stamenocella inferaviculifera* cause two shallow cavities between the opesiae.

Pl. 3, fig. 5, shows a rather well preserved specimen which seems to be intermediate between *Flustrella marginata* d'Orbigny and *Flustrella convexa* d'Orbigny. The basal region, which tapers proximally and shows a radicelled base, has zoecia corresponding to those of *Flustrella convexa*. They are closed by a calcareous lamella and pierced by elliptical or round openings as can also be observed in other species of *Stamenocella*.

The variation in the size of the opesiae is enormous in this species as shown in pl. 3, fig. 5, and the following measurements:

$$L_z = 0.50-0.63 \text{ mm.}$$

$$l_z = 0.17-0.25 \text{ mm.}$$

$$L_o = 0.17-0.33 \text{ mm.}$$

$$l_o = 0.07-0.15 \text{ mm.}$$

STRATIGRAPHICAL RANGE. Maastrichtian.

SPECIMENS. D.47322. A fragment embedded in the matrix of *Onychocella bathonica* Gregory (D. 181). Upper Maastrichtian, Cotentin, Manche, France.

D.49586. A fragment from the matrix of D. 181. Upper Maastrichtian, Cotentin, Manche, France.

D.49587. A small worn fragment. Locality and horizon as above. A well preserved fragment showing the stage of *Flustrella convexa* d'Orbigny at the base of the zoarium. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France, Voigt Collection, Hamburg, Nr. 4128.

Type specimen of *Biflustra tessellata* d'Orbigny. Upper Maastrichtian, Néhou, Cotentin, Manche, France. d'Orbigny Collection, Paris, Musée d'Histoire Naturelle. Nr. 8053.

Genus *THYRACELLA* Voigt 1930

16. *Thyracella* cf. *meudonensis* (d'Orbigny)

(Pl. 2, figs. 4-6)

cf. 1851 *Biflustra meudonensis* d'Orbigny: 263, pl. 692, figs. 4-6.

1951 *Thyracella* cf. *meudonensis* (d'Orbigny) Voigt: 59, pl. 9, figs. 4-5.

Three fragments of this bilaminar species are conspecific with a "*Biflustra*" which is very abundant in the Maastrichtian of Port Filiolet (Manche). It has a very prominent large avicularium as is typical of *Thyracella* (pl. 2, fig. 4). I think it could be identified with *Biflustra meudonensis* d'Orbigny recorded by him from Néhou and Meudon. In the catalogue of the d'Orbigny collection only one fragment from the Chalk of Meudon is registered under Nr. 8090 although I possess more than fifty specimens from this locality which would fit very well into that species. It is worn and does not correspond with the figure; it does not look like a chalk fossil from Meudon, but seems to have come from a more littoral facies resembling the Maastrichtian of the Cotentin. The worn specimens, described and figured by the present author from the Maastrichtian of Kunrade (S-Limburg) and Ilten (northern Germany) give a different impression from that of the well preserved material from the Cotentin localities in the author's collection. But there are all intermediate stages. For comparison a photograph of a characteristic specimen with a large avicularium, from Port Filiolet (Manche), is given (pl. 2, fig. 4). The length of the avicularium is *c.* 0.8 mm., and that of the zoecia *c.* 0.5-0.6 mm. The well preserved zoecia always have a sharp and distinct margin in the distal part as shown in the figure of d'Orbigny.

STRATIGRAPHICAL RANGE. Maastrichtian and (fide d'Orbigny) Upper Campanian.

SPECIMENS. D.49588. A damaged fragment from the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49846. A fragment embedded in matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49589-90. Two fragments from the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

A well preserved branched fragment with an avicularium. Upper Maastrichtian, Port Filiolet, Cotentin, Manche, France. Voigt Collection, Hamburg. Nr. 3919.

A worn fragment labelled Meudon but likely. Upper Maastrichtian, locality uncertain (? Néhou, Cotentin, Manche). d'Orbigny Collection, Paris, Musée d'Histoire Naturelle Nr. 8040.

Genus *VINCULARIA* (auct.)

The genus *Vincularia* Defrance is here understood in the sense of the older authors, although this is not correct according to the rules of nomenclature. *Vincularia* is now restricted to those forms which Canu 1907 named *Heterocella*. But *Vincularia fragilis* Defrance 1829 from the Eocene is the type species of the genus of *Vincularia* (cf. Bassler 1953 : 157) and the name *Vincularia* must be reserved for this group. *Heterocella*, therefore, as a synonym of *Vincularia*, must be dropped.

The consequence of this is that there is no name available for the many Cretaceous species of "*Vincularia*" of d'Orbigny, Marsson, Brydone and other authors. Canu (1900) has united most species of *Vincularia* under *Smittipora* Jullien (1881), which Bassler (1953) considered con-generic with *Diplopholeos*, *Rectonychocella* and *Velumella* Canu & Bassler. But the definition of *Smittipora* does not fit most "*Vincularias*". Admitted that *Vincularia* has been established primarily as a zoarial growth-form for rod-like stems, there still exists a natural group of forms for which this name has been used and for which another name does not yet exist. On the other hand it seems to be necessary to distinguish the forms which are radicelled or articulated at their base from those which are attached by an encrusting base. This is not the place to give a new classification of *Vincularia*, and it is necessary to retain the old name provisionally.

17. *Vincularia canalifera* von Hagenow

(Pl. 5, figs. 7-10 and Pl. 8, figs. 9-12)

- 1851 *Vincularia canalifera* von Hagenow: 61, pl. 6, fig. 14.
 ?1851 *Vincularia flexuosa* d'Orbigny: 76, pl. 656, figs. 16-18.
 1930 *Vincularia canalifera* von Hagenow; Voigt, 467, pl. 17, fig. 18.

More than thirty fragments of this species were found in the matrix of D.181. They are conspecific with the most common *Vincularia*-species of Maastricht and Kunrade (Netherlands) which was described by von Hagenow as *Vincularia canalifera*. Von Hagenow's figure is not quite typical because the length of the opesia is relatively large, about one third or one quarter of the length of the zoecium. Among some hundred fragments there are only two which correspond to von Hagenow's figure, but this species can show great variation in size and shape of the zoecia and opesiae. The opesia varies between an oval (pl. 5, figs. 7, 9, 10) or more semicircular (pl. 5, fig. 8, pl. 8, figs. 9-11) opening which is truncated more or less proximally. In well preserved specimens it has a slight margin, but never a proximal lip. In the proximal basal region the zoecia are 0.25 mm. long, and when fully developed 0.5 mm.; the length of the opesiae is 0.10-0.17 mm. The avicularia, which have not been figured until now, reach the length of the zoecia or exceed it (pl. 5, fig. 8, pl. 8, figs. 10, 11). They are rare, straight, and appear at the beginning of a new row of zoecia, or are normally enclosed in these. They are broader than the autozoecia and have a flatly rounded prominent distal rim and a small elliptical

opesia which is longitudinally oriented. Common to the zooecia and the avicularia is a furrow-like deepening in the median axis of the cryptocyst from which the specific name is derived. Ovicells have never been observed.

The rods have a diameter of 0.5–0.7 mm. and consist of eight to fourteen rows of zooecia. They taper proximally and were articulated or radicelled at their base. This is shown by some of the earliest zooecia which seem to be modified to lodge chitinous rootlets (pl. 5, fig. 7). Their opesiae are smaller and their upper half is covered by a bent calcitic lamella as is seen also in other articulated or radicelled forms.

This species is also common in the Maastrichtian of the Cotentin near Port Filiolet, Fresville and Chef du Pont from which region d'Orbigny described some very similar vincularian species.

I take it that *Vincularia flexuosa* d'Orbigny is conspecific with this species, which is cited by d'Orbigny from Néhou in the Cotentin and from the Santonian of Vendôme. I have studied the type (Nr. 7752 in the d'Orbigny collection) and I cannot find any significant differences. It is figured on pl. 8, fig. 14 for comparison with specimens from Maastricht (pl. 5, figs. 7 and 8 and pl. 8, figs. 11 and 12). The reason why I hesitate to place this species under d'Orbigny's name is, that according to the label the type specimen is from the Santonian of Vendôme (as stated also in his catalogue) although I suspect that it comes from Néhou in the Cotentin. Because it is not clear if the holotype comes from the Cotentin, I prefer the name *Vincularia canalifera* which is given by von Hagenow in the same year as d'Orbigny's name.

Another form from the Cotentin which is very similar to *Vincularia canalifera* is *V. concinna* (d'Orbigny 1851 : 79, pl. 657, figs. 10–12). It may be another synonym. D'Orbigny's holotype is figured on pl. 8, fig. 13; this is the only specimen of this species in the d'Orbigny Collection of Nr. 7756). This specimen, recorded by Canu (1900 : 420) as "insuffisant", has opesiae also which are about 0.11–0.17 mm. long, but the cryptocyst seems to be less deepened than in *Vincularia canalifera* von Hagenow. Unfortunately it shows no avicularia, knowledge of which is very important for the discrimination of many species of *Vincularia* which are very similar and cannot be identified from the work of d'Orbigny. D'Orbigny never figured or mentioned in his species the avicularia, which are rather rare and similar to the autozooecia.

STRATIGRAPHICAL RANGE. Maastrichtian.

SPECIMENS. D.49732. Branched fragment, Upper Maastrichtian, Geulem near Berg, Geul-Valley near Maastricht, Netherlands. Voigt Collection.

D.49733, D.49735–36, D.49737–66. Fragments from the matrix of D.181, Upper Maastrichtian, Cotentin, Manche.

D.49734. Fragment, Upper Maastrichtian Chef du Pont, Cotentin, Manche. Voigt Collection.

D.49840–41. Two fragments, Upper Maastrichtian, St. Pietersberg near Maastricht, Netherlands. Voigt Collection.

D.49842. Fragment, Upper Maastrichtian, St. Pietersberg near Maastricht, Netherlands. Voigt Collection.

Genus *QUADRICELLARIA* d'Orbigny 185018. *Quadricellaria elegans* d'Orbigny

(Pl. 6, figs. 8-10)

1851 *Quadricellaria elegans* d'Orbigny: 33, pl. 652, figs. 1-5.1900 *Quadricellaria elegans* d'Orbigny; Canu: 413.1928 *Quadricellaria excavata* d'Orbigny; Voigt: 112, text-figs. 1-5.1930 *Quadricellaria excavata* d'Orbigny; Voigt: 489, pl. 25, figs. 12-14.

Two small fragments of a *Quadricellaria* may be determined as *Q. elegans* d'Orbigny. The size of the opesia compared with the length of the zooecia varies considerably, and Canu may be right in uniting d'Orbigny's three species, *Q. elegans*, *Q. excavata* and *Q. pulchella*, under the name *Q. excavata*, as I did in 1928. My specimens agree largely with the figures of *Q. elegans* d'Orbigny which was first recorded from Néhou (Manche).

This species is represented in my material from Chef du Pont and Port Filiolet. One specimen from Chef du Pont has, on the narrow sides of the segments, two enormous avicularia which are 1 mm. long and have an opesia with a length of 0.3 mm. (pl. 6, fig. 10).

SPECIMENS. D.49591-92. Two worn fragments. From matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

A fragment with a large avicularium. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Voigt Collection, Hamburg, Nr. 4133.

Genus *COSCINOPLEURA* Marsson 188719. *Coscinopleura* sp.

Two minute indeterminable fragments of a *Coscinopleura*, showing only a few zooecia are present. They possibly belong to a species of *Coscinopleura* with small zooecia, like *Coscinopleura lamourouxii* von Hagenow, or to a similar form. Common in the Cotentin Maastrichtian near Port Filiolet and Chef du Pont (Manche).

SPECIMENS. D.49593-94. Two small worn fragments. From the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

Genus *SEMIESCHARINELLA* d'Orbigny 1852¹20. *Semiescharinella complanata* d'Orbigny

(Pl. 4, figs. 11-15)

1840 *Cellepora ricata* von Hagenow: 616.1852 *Semiescharinella complanata* d'Orbigny: 427, pl. 714, figs. 1-4.

¹D'Orbigny published his genera *Semiescharinella* and *Reptescharinella* on p. 427 and p. 428 of his work. According to Sherborn (*Geol. Mag.* 1889: 223-225) pages 187-472 appeared in 1852. I follow here the dates given by Sherborn, although Lang (1917: 172) states 1853 for *Reptescharinella* and d'Orbigny himself writes 1851 for both genera.

- 1852 *Escharinella simplex* d'Orbigny: 205, pl. 683, figs. 14-16.
 1900 *Rhagasostoma simplex* (d'Orbigny); Canu: 433.
 1930 *Micropora subgranulata* (von Hagenow) Voigt (pars): 476, pl. 24, fig. 18 (non 19).
 1959 *Semiescharinella complanata* (d'Orbigny) Voigt: 54, pl. 6, fig. 1.
 1962 *Semiescharinella complanata* (d'Orbigny) Berthelsen: 134, pl. 14, figs. 2-3.

Two very small unilaminar fragments agree very well with some specimens from Chef du Pont and with d'Orbigny's type-specimen from Sainte Colombe (Manche). The size of the zooecia is a little less in the type-specimen (about 0.56-0.60 mm.) compared with 0.70 mm. in D.49595-96; but the abundant material in the author's collection shows that the size of the zooecia and opesiae is highly variable in this species. The "TYPE" is a fragment, with *c.* 18 zooecia, in which the relative length and width of the zooecia differ from d'Orbigny's figure as noted by Canu (1900 : 421), although in the catalogue of the d'Orbigny Collection only one specimen from Sainte Colombe (Manche) is registered. The bilaminar *Escharinella simplex* d'Orbigny from Néhou (Manche) belongs to the same species. The distal pore which was interpreted by Canu as the trace of the ovicell is a true avicularium. Nevertheless, there are some real ovicells which are developed in place of the avicularia (see pl. 4, fig. 15).

Comparison of the photographs (pl. 4, figs. 13-15) shows that there is no variation in the shape or size of the zooecia, nor of the opesiae, nor amongst the distal avicularia. I have figured the only poor fragment from the d'Orbigny collection which must be regarded as the type specimen (pl. 4, fig. 15). This species is congeneric with *Cellepora* (*Discopora*) *subgranulata* von Hagenow (1851 : 91, pl. 11, fig. 15) which was chosen by Lang (1917 : 172) as the type species for the genus *Reptescharinella* d'Orbigny 1852. D'Orbigny had united under this name eight Cretaceous, one Tertiary and two Recent species, of quite distinct systematic differences, said to be characterized by an "ouverture mediocre", a "pore spécial" and encrusting zoaria. The genus *Semiescharinella* was not discussed by Lang, being represented only by *Semiescharinella complanata* d'Orbigny. There is no doubt what d'Orbigny meant by this name, and I prefer it, proposing to drop *Reptescharinella* as a synonym of *Semiescharinella*, the mode of growth being no generic criterion. This form was first described by von Hagenow 1840 under the name *Cellepora ricata* without any figure (Voigt 1959 : 54).

STRATIGRAPHICAL RANGE. Maastrichtian-Danian.

SPECIMENS. D.49595-96. Two small worn fragments. From the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49847. A small fragment. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Voigt Collection.

A small fragment showing an ovicelled zooecium. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Voigt Collection Hamburg Nr. 3918b.

Bilaminar fragment, Holotype of *Escharinella simplex* d'Orbigny. Upper Maastrichtian, Néhou, Cotentin, Manche, France. d'Orbigny Collection, Paris, Musée d'Histoire Naturelle Nr. 7942.

Genus *ROSSELIANA* Jullien 188821. *Rosseliana thomasi* sp. n.

(Pl. 1 fig. 6, and Pl. 4, figs. 4-6)

TYPE SPECIMEN. D.49597. Zoarium encrusting a branched fragment of *Radulopora minor* n. g. n. sp. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Collection E. Voigt.

DERIVATIO NOMINIS. In honour of Dr. Dighton Thomas, London, who first detected this species in the matrix of *Castanopora jurassica* (Gregory).

DIAGNOSIS. A *Rosseliana* with encrusting zoarium. Zooecia very small, oval, only 0.33 mm. long, with smooth cryptocyst and sharply raised rim in the distal region of the zooecia. Opesiae semicircular, occupying nearly a third of the length of the zooecia, sometimes with very inconspicuous lateral processes, but never trifoliate in shape; its lower rim is straight without opesiules. Ovicells globular swellings above the opesia and occupying the proximal part of the distal zooecium.

DESCRIPTION. In addition to the British Museum specimen, which encrusts a branch of *Multicrescis laxata* d'Orbigny, there are two others from Chef du Pont (Manche). They show, although they are more fragile, the same essential specific characters, having no avicularia and no trifoliate opesiae. In some zooecia, very minute lateral processes might indicate a *Floridina*-like opesia, but this is so negligible that it can be ignored. They are therefore classified as *Rosseliana* and not *Floridina* or *Floridinella*. Nevertheless, it is clear that the difference between *Rosseliana* and *Floridinella*, based only on the existence of broad opesiular indentations in the latter, is slight. The specimens are very similar to that figured by Bassler (1953, fig. 130.4), but he only records *Rosseliana* from the Oligocene to Recent.

There are very few species with which this form could be compared. The shape and size of zooecia are very similar in *Floridina* (or better *Floridinella*) *scutata* Levinsen (1925 : 345, pl. 4, fig. 39) from the Danish Maastrichtian Chalk and Danian, and *Semieschara complanata* d'Orbigny (1852 : 369, pl. 708, figs. 5-8). Apart from the free unilaminar fronds of the latter, it is very difficult to find any constant difference between these two forms, which are distinguished from our new *Rosseliana thomasi* only by their opesiae, always markedly trifoliate as in *Floridina* or *Floridinella*. Pl. 4, fig. 7, shows a specimen of *Floridinella scutata* Levinsen from a Maastrichtian flint drift boulder from northern Germany. The difference of this species from *Rosseliana thomasi* n. sp. is clearly seen in the opesia which has significant lateral indentations.

STRATIGRAPHICAL RANGE. Upper Maastrichtian.

SPECIMENS. D.47323. Encrusting zoarium with some ovicelled zooecia on *Multicrescis laxata* d'Orbigny (= D.49575). In the matrix of *Castanopora jurassica* (Gregory) (D.180) Upper Maastrichtian, Cotentin, Manche, France.

Zoarium encrusting an echinoid fragment. Upper Maastrichtian, Port Filiolet, Cotentin, Manche, France. Voigt Collection, Hamburg, Nr. 3932.

Genus *MICROPORA* Gray 1848 (non Eichwald 1855)22. *Micropora transversa* (d'Orbigny)

(Pl. 7, figs. 9-12)

1851 *Vincularia transversa* d'Orbigny: 78, pl. 657, figs. 7-9.1887 *Vincularia rugica* Marsson: 65, pl. 6, fig. 8.1930 *Micropora rugica* (Marsson) Voigt: 472, pl. 21, fig. 20.1951 *Micropora rugica* (Marsson) Voigt: 63, pl. 9, fig. 10 and pl. 10, fig. 4.

HOLOTYPE. Two minute fragments evidently 2 pieces of one specimen. Upper Maastrichtian, Néhou, Cotentin, Manche, France. d'Orbigny Collection, Paris, Musée d'Histoire Naturelle Nr. 7755.

There is only a very small fragment corresponding to the length of a single zoecium of this species in the matrix of D. 181. The two symmetrical opesiules below the opesia show clearly that it must belong to *Vincularia transversa* d'Orbigny, the type of which, from Néhou, (pl. 7, figs. 10-11) was studied by the author. There is only one poorly preserved fragment in d'Orbigny's collection which is recorded in his catalogue. It is now broken into two pieces. It does not correspond to d'Orbigny's figure and description, because the paired opesiules, which are clearly visible, are neither mentioned in his text nor figured in his drawing; they seem to be indicated by the deep furrows accompanying the thick margin of the zoecia, but they do not correspond to what d'Orbigny called "une dépression lanceolée" which is situated below the aperture. This depression must correspond to the lanceolate cryptocyst of d'Orbigny's figure. I found some well preserved fragments at Port Filiolet and Chef du Pont (Cotentin), see pl. 7, fig. 12.

This form is conspecific with Marsson's *Vincularia rugica* as is proved by many specimens from the Maastrichtian Chalk of Rügen and other localities in northern Germany. Marsson who published the first good description and figure of this species, was therefore unable to recognize that his species was the same as d'Orbigny's, and it is understandable that, since Marsson's description, this form has been recorded only under the name *rugica*. Another similar species is *Vincularia undata* d'Orbigny from the Santonian of Vendôme, which also has true opesiules below the opesia, not indicated in d'Orbigny's figure (d'Orbigny 1851: 75, pl. 656, figs. 10-12) but which can be seen on the holotype.

The appearance of *Micropora transversa* can vary considerably as shown in Voigt's figures (1951). The diameter of the rods is from 0.5-0.7 mm., and the number of zoecial rows varies between five and ten. The length of the normal zoecia is 0.49-0.54 mm. The basal attenuated part of some rods shows clearly that this species was articulated or radicelled (cellariform). This means that this form is not congeneric with all true *Micropora*, and it could be suggested that it belongs to a new genus. But I hesitate to erect a new genus for it because it is not impossible that this form is conspecific with *Dimorphostylus tetrastichus* Voigt 1928. The genus *Dimorphostylus* was established for articulated rods, in which the zoecia are only developed on one side. But the size and other features of the

zoecia in *Micropora rugica* and in *Dimorphostylus tetrastichus*, which are often associated together in the same localities, are identical, and there is the suspicion that *Dimorphostylus tetrastichus* might represent specimens with the zoecia developed only on one side, and that the differentiation in a frontal and reversed side may be pathological. The two forms have not yet been found united in one specimen, but if they were, the generic name *Dimorphostylus* must be applied to *Micropora transversa* d'Orbigny. Therefore it is provisionally here referred to *Micropora*, which also indicates that it may belong to the Microporidae.

STRATIGRAPHICAL RANGE. Maastrichtian; Lower Maastrichtian of Rügen and Denmark and Upper Maastrichtian of the Cotentin (Manche), Maastricht and Ilten near Hanover.

SPECIMENS. D.49768. A minute fragment. From matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49769. A well preserved fragment. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Voigt Collection.

Genus *PUNCTURIELLA* Levinsen 1925

23. *Puncturiella* cf. *superba* Brydone

(Pl. 4, figs. 8-10)

1936 *Puncturiella superba* Brydone: 84, pl. 40, fig. 18.

The small unilaminar fragment with about a dozen poorly preserved zoecia, shows the cryptocyst pierced by two outer and two inner rows of pores. These are barely visible because they are partly obscured by recrystallization of the calcite, and the distal avicularium which is directed obliquely is very obscure. However the identity of this specimen with a few unilaminar fragments from Fresville and Chef du Pont is evident (pl. 4, figs. 8-9), and they are probably identical with some very similar specimens from Maastricht which are free or encrusting, but whose dimensions are a little larger.

The average length of zoecia from the Cotentin localities is about 0.65-0.70 mm., that from Maastricht 0.80-1.00 mm., although some zoecia from the two localities are the same size, and it may be that the difference is ecological. The only form with which D.49598 can be identified is *Puncturiella superba* Brydone from the Lower Maastrichtian Chalk of Trimmingham (Norfolk), in which the zoecia are about 0.65-1 mm. long.

STRATIGRAPHICAL RANGE. Maastrichtian.

SPECIMENS. D.49598. A small worn fragment embedded in matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49599. A small fragment. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Voigt Collection.

D.49600. A small well preserved fragment in matrix. Upper Maastrichtian Md, St. Pietersberg near Maastricht. Voigt Collection.

Genus *LUNULITES* Lamarck

24. *Lunulites* sp.

One very small fragment which is worn and shows a few zooecia is indeterminable. It seems to be conspecific with one of the numerous species of *Lunulites* represented in the Maastrichtian of the Cotentin.

SPECIMENS. D.49601. A very small indeterminable fragment. In matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

Genus *ONYCHOCELLA* Jullien 1881

25. *Onychocella nysti* (von Hagenow)

(Pl. 6, figs. 3-4)

1851 *Eschara nysti* von Hagenow: 78, pl. 9, figs. 15-17.

1930 *Onychocella nysti* (von Hagenow) Voigt: 459, pl. 16, figs. 14-16.

One small fragment belongs to this species which is very common at all European Maastrichtian localities and which I found at Port Filiolet and Chef du Pont (Manche). It has not previously been recorded from the Cotentin Maastrichtian.

STRATIGRAPHICAL RANGE. Campanian-Maastrichtian.

SPECIMENS. D.49602. A worn fragment. From the matrix of D.181. Upper Maastrichtian. Cotentin, Manche, France.

D.49603. A well preserved fragment. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Voigt Collection.

26. *Onychocella* cf. *cepha* (d'Orbigny)

(Pl. 6, figs. 1-2)

1851 *Eschara cepha* d'Orbigny: 143, pl. 670, figs. 8-10.

Two fragments of a narrow *Onychocella* belong to a species which is very abundant near Chef du Pont (Manche) and which is not distinguishable from an *Onychocella* from the Maastrichtian of Archiac (Gironde). Of the numerous species of *Onychocella* described by d'Orbigny from the French Cretaceous, the only one which can be compared with this form is *Eschara cepha* d'Orbigny from Royan, although the type-specimen has more slender zooecia and thinner rims surrounding the zooecia. Comparison with the type alone would suggest a different species, but when compared with all the material from Archiac and Chef du Pont, these differences are much diminished and identity is more justified than the foundation of a new species.

STRATIGRAPHICAL RANGE. Maastrichtian.

MEASUREMENTS.

$$L_z = 0.48-0.55 \text{ mm.}$$

$$l_z = 0.30-0.37 \text{ mm.}$$

$$h_o = 0.10-0.17 \text{ mm.}$$

$$l_o = 0.10-0.13 \text{ mm.}$$

$$L_{av} = 0.70-0.75 \text{ mm.}$$

SPECIMENS. D.49604. A branched fragment. From the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49605. A small fragment. From the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49606. A fragment. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Voigt Collection.

27. *Onychocella bellona* (d'Orbigny)

(Pl. 6, figs. 5-7)

1851 *Eschara bellona* d'Orbigny: 134, pl. 668, figs. 7-9.

1900 *Rhagasostoma bellona* (d'Orbigny) Canu (pars): 431.

Two fragments of this broad bilaminar species agree in all details with the material collected by the author at Chef du Pont (Manche) and with as specimen in d'Orbigny's collection from Néhou (Manche). (d'Orbigny Collection Nr. 7812.)

The small difference between the diameter of the apertures in our figured specimen and that of d'Orbigny is irrelevant because it is also shown in the specimens from Chef du Pont. The opesiae of the fertile zooecia are a little longer than the others. This species belongs to the group of *Onychocella lamarcki* von Hagenow, which is closely allied to it; but the latter always shows more slender branches (1.2-2.0 mm. diameter), and shorter and thicker zooecia, and the difference in size of the fertile and non fertile zooecia is much more evident than in *Onychocella bellona* d'Orbigny.

It is the same with the fertile zooecia of *Onychocella lamarcki* von Hagenow from Maastricht, but the zoaria of that species are always flat and lamellar.

MEASUREMENTS.

$$L_z = 0.60-0.70 \text{ mm.}$$

$$l_z = 0.33-0.45 \text{ mm.}$$

$$h_o = 0.12-0.18 \text{ mm.}$$

$$l_o = 0.12-0.19 \text{ mm.}$$

$$L_{av} = 0.75-1.00 \text{ mm.}$$

$$l_{av} = 0.22-0.27 \text{ mm.}$$

This species has been found only in the Cotentin Maastrichtian.

STRATIGRAPHICAL RANGE. Upper Maastrichtian.

SPECIMENS. D.49607. A worn fragment. From the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49608. A well preserved fragment. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Voigt Collection.

A well preserved fragment with ovicelled zoecia. Upper Maastrichtian, Néhou, Cotentin, France. d'Orbigny Collection, Paris, Musée d'Histoire Naturelle Nr. 7812.

Genus *ONYCHOCELLARIA* Voigt 1957

28. *Onyhocellaria caecilia* (d'Orbigny)

(Pl. 5, figs. 1-6)

1851 *Eschara caecilia* (d'Orbigny): 138, pl. 669, figs. 4-7.

The zoarium was cellariiform in growth. This is proved by the tapering proximal ends of the segments and by pits occasionally found on the cryptocyst in which rootlets are inserted. This criterion, combined with the straight avicularia, puts it in the genus *Onyhocellaria*, although the endozoecial ovicell, which is characteristic for this genus, has not yet been observed.

The zoecia, the length of which is 0.4-0.5 mm., are nearly rectangular and are very often distinguished by a small horizontal band above the distal rim of the opesia. The slit-like pit between the opesia and this band is very characteristic, and is shown in d'Orbigny's figures. The opesiae, which vary greatly in size, may be rounded or oval to high-semicircular. In some segments the whole opesia or its upper half is closed by a calcareous lamella.

MEASUREMENTS.

$$L_z = 0.42-0.51 \text{ mm.}$$

$$l_z = 0.20-0.25 \text{ mm.}$$

$$h_o = 0.10-0.70 \text{ mm.}$$

$$l_o = 0.10-0.11 \text{ mm.}$$

$$L_{Av} = 0.55-0.58 \text{ mm.}$$

$$l_{Av} = 0.25-0.30 \text{ mm.}$$

This species is represented by many small fragments. It is characteristic of the Maastrichtian of the Cotentin, and has also been found in abundance by the present author near Port Filiolet (Manche). The specimens agree entirely with the original specimens of d'Orbigny from the Maastrichtian of Néhou. These are not "usé" as stated by Canu (1900 : 420).

STRATIGRAPHICAL RANGE. Upper Maastrichtian.

SPECIMENS. D.49726. A small fragment with avicularia. From the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49727. Another fragment with avicularium. From the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49728-29. Two worn fragments. From the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49767. A small fragment corresponding in preservation to D.49730. From the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49849-54. 6 fragments from the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49848. Eight very worn small fragments from the matrix of D.181. Locality and horizon as above.

D.49730. A well preserved fragment with some avicularia. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Voigt Collection.

D.49731. A well preserved fragment. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Voigt Collection.

Genus *PLIOPHLOEA* Gabb & Horn 1862

29. *Pliophloea* sp.

(Pl. 7, fig. 3)

Of this species there is but one encrusting young zoarium, which is composed of the ancestrula and a dozen zooecia. The ancestrula is 0.20 mm. long and the other zooecia have a length up to 0.50 mm. The smooth intraterminal front wall shows about twelve to thirteen costae which are barely visible. The orifice is cribriline to slightly pliophloean according to Lang's definition. There is only one avicularium—if the interpretation as avicularium is correct—which is *c.* 0.20 mm. long and which is close to the ovicelled zooecium on the right of our figure. Details of the spines are not visible. *Pliophloea gluma* Lang (1921 : 188, pl. 6, fig. 3) from the Danian shows some affinities in the shape of the zooecia and the apertures, but has clearly distinct costae, and visible intercostal fusions, and the zooecia are only 0.40 mm. long. There is no other species hitherto described with which this form can be identified and therefore it may be supposed that it is a new one. But this one poor specimen does not suffice to found a new species.

STRATIGRAPHICAL RANGE. This form has not previously been observed in the Maastrichtian of the Cotentin.

SPECIMENS. D.47324. Small encrusting zoarium with ancestrula and an ovicelled zooecium. In the matrix of *Castanopora jurassica* (Gregory) D.180. Upper Maastrichtian, Cotentin, Manche, France.

Genus *DECURTARIA* Jullien 1886

(= *Prosoporella* Marsson 1887)

30. *Decurtaria* cf. *cornuta* (Beissel)

(Pl. 7, figs. 1-2)

1865 *Semiescharipora cornuta* Beissel: 58, pl. 7, figs. 77-81.

1887 *Prosoporella cornuta* Marsson: 100.

1922 *Decurtaria cornuta* (Beissel) Lang: 388, text-fig. 124, pl. 8, fig. 9.

1925 *Barroisina trifossata* Levinsen: 387, pl. 8, fig. 6.

1930 *Decurtaria cornuta* (Beissel) Voigt: 516, pl. 32, fig. 6.

This species is represented by a fairly large zoarium composed of about thirty zooecia. Unfortunately it is covered by a film of minute calcite-crystals which hides many of the characteristic minute details of the costae and the orifices. The small number of costae (six to seven) and the very stout distal shield indicate it to be *Decurtaria cornuta*, although the shape of the orifice is more like that of *Decurtaria allecta* Lang (1922 : 386, pl. 8, fig. 8) from the Upper Maastrichtian of Maastricht. D.49609 corresponds exactly to a fragment from Chef du Pont (Manche). In some respects that form might be regarded as intermediate between the two species, which are, indeed, more alike than is stated by Lang who had only one specimen of his *D. allecta* from Maastricht. *Decurtaria cornuta* is not confined to the Lower Maastrichtian as might be concluded from Lang's work. I found a small but typical fragment of this species in the Upper Maastrichtian of Biebosch (South Limburg, Netherlands).

It seems that the shape of the orifice is not so constant as was assumed by Lang. According to him, in *D. cornuta* the orifice should be "super-cribriline" and in *D. allecta* "supernormal". But Beissel had already stated that the different types of orifice shape may be observed in the same zoarium, and he has figured both forms in his figs. 77 and 78. The size of the zooecia is between 0.57 and 0.65 mm. *Barrosina trifossata* Levinsen is a synonym of this species which I concluded from the examination of Levinsen's type specimen.

STRATIGRAPHICAL RANGE. Maastrichtian.

SPECIMENS. D.49609. A complete zoarium with ancestrula and some ovicelled zooecia. From the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

An incomplete zoarium. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Voigt Collection, Hamburg, Nr. 4137.

Genus *FRURIONELLA* Canu & Bassler 1926

30. *Frurionella fertilis* sp. n.

(Pl. 8, figs. 5-7)

HOLOTYPE. D.49610. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Collection E. Voigt.

DERIVATIO NOMINIS. Derived from *fertilis* = generative, on account of the numerous ovicells.

DIAGNOSIS. A slender species of *Frurionella*, with bilaminar branches consisting of three to four alternating rows of zooecia. Zooecia not distinct, small, with quadrangular to high triangular or semicircular opesiae whose proximal margin is straight and generally provided with an inconspicuous proximal lip caused by the swelling of the median avicularium below the opesia. Elliptical or linear indistinct pores which may be avicularia are developed in the median axis of the zooecium. Ovicells numerous, forming deep characteristic cavities above the apertures if the covering lamina has been destroyed.

MEASUREMENTS.

$$L_z = 0.50-0.62 \text{ mm.}$$

$$h_0 = 0.10-0.12 \text{ mm.}$$

$$l_0 = 0.10-0.12 \text{ mm.}$$

REMARKS. A small fragment, showing a scarcely constricted opesia with a minute avicularium below it, has been recognized as belonging to this new species which is represented from Chef du Pont by two other similar specimens. This form cannot be identified with any of the few known species of *Frurionella*. It is smaller in its zoarial and zoecial dimensions than the other species of this genus. At first it was supposed that it might be the slender distal branch of another new species of *Frurionella* which is much larger and very common at Fresville (Cotentin, Manche). This is improbable because there are no intermediate stages between these two very different forms and no distal branches smaller than 2-1.5 mm. seem to exist in the second species. This other species of *Frurionella* from Fresville (pl. 8, fig. 8) is conspecific with *Frurionella europaea* Voigt (1951 : 60, pl. 9, figs. 1-3) from the Upper Maastrichtian of Ilten (Hannover) and Kunrade (Netherlands). It has now also been found at Maastricht (Netherlands).

STRATIGRAPHICAL RANGE. Maastrichtian.

SPECIMENS. D.49610. Holotype see above.

D.49611. A small worn fragment in matrix. From the matrix of D.181. Upper Maastrichtian, Contentin, Manche, France.

D.49612. A fragment with broken ovicelled zoecia. Horizon and locality as above.

Genus *BEISSELINA* Canu 191332. *Beisselina striata* (Goldfuss)

(Pl. 8, figs. 3-4)

1826 *Eschara striata* Goldfuss: 25, pl. 8, fig. 16.

1960 *Beisselina striata* (Goldfuss) Wiesemann: 27, pl. 1, figs. 1-3, pl. 2, figs. 3-4; pl. 12, figs 3-4; text-figs. 3e, 4 9-10; 5, Nrs. 12-13 (with additional synonymy).

1967 *Beisselina striata* (Goldfuss) Voigt: 72, pl. 25, fig. 1.

One specimen belongs to this common Maastrichtian species which is, according to Wiesemann, represented near Chef du Pont (Manche). Nevertheless the diameter of the stem (1.5 mm.) and the orifices (peristomia) are a little smaller (0.08-0.12 mm.) than in most specimens from the type locality of Maastricht, and Kunrade, although the length of the zoecia (distance between proximal and distal apertures) is the same. Specimens with such small orifices are not lacking, and all intermediate sizes occur at these localities, but they are rare. For comparison see pl. 8, fig. 4, showing the surface of a worn specimen from Maastricht itself. These small forms are more common in the "Tuffeau de St. Symphorien" in the Basin of Mons (Belgium.)

STRATIGRAPHICAL RANGE. Maastrichtian.

SPECIMENS. D.49721. A worn fragment. From the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

D.49722. A worn fragment. Upper Maastrichtian, Geulem, near Berg, Geul valley near Maastricht (Netherlands). Voigt Collection.

Genus *BEISSELINOPSIS* Voigt 1951

33. *Beisselinopsis flabellata* (d'Orbigny)

(Pl. 8, figs. 1-2)

1852 *Escharifora flabellata* d'Orbigny: 460, pl. 715, figs. 10-12.
non 1930 *Beisselina flabellata* (d'Orbigny) Voigt: 525, pl. 34, fig. 11.

One incomplete young zoarium represents d'Orbigny's species which is common at Sainte Colombe (Manche) and the type of which from this locality was studied by the present author. There are some specimens from Chef du Pont (Manche) which agree very well with *Beisselinopsis flabellata* d'Orbigny although they are more elongate than the flabelliform zoarium of d'Orbigny's type specimen. The species identified as *Porina flabellata* (d'Orbigny) by Marsson (1887 : 85) is *Beisselinopsis marginata* v. Hagenow 1839 (cf. Voigt 1959 : 11, pl. 9, figs. 1-2). The similar Danian and Montian form determined as *Porina* or *Beisselina flabellata* (d'Orbigny) by Levinsen (1925, pl. 7, fig. 83) and Voigt (1930 partim : 525, pl. 34, fig. 11) is neither conspecific nor congeneric and corresponds to *Eschara oblita* Kade (1852 : 29, pl. 1, fig. 18) as stated by Berthelsen (1962 : 201, pl. 24, fig. 6) and Voigt (1964 : 458, pl. 8, fig. 8 and pl. 14, figs. 1-3) and belongs to the genus *Pavobeisselina* Voigt 1964. It was formerly assigned to *Beisselinopsis* Voigt 1951, but this attribution was incorrect because *Beisselinopsis* has no ascopore which can always be observed in *Pavobeisselina*. The inner structure of *Beisselinopsis flabellata* d'Orbigny does not show any ascopore in the frontal wall as is always the case in *Beisselina* and flabelliform *Pavobeisselina*. Therefore it must be regarded as a true *Beisselinopsis*.

STRATIGRAPHICAL RANGE. Upper Maastrichtian.

SPECIMENS. D.49723. A young zoarium. From the matrix of D.181. Upper Maastrichtian, Cotentin, Manche, France.

An adult zoarium. Upper Maastrichtian, Chef du Pont, Cotentin, Manche, France. Voigt Collection, Hamburg, Nr. 3908.

II. BRACHIOPODA

Genus *THECIDEA* Defrance 1832

Thecidea papillata (von Schlottheim)

(Pl. 1, figs. 9-10)

1959 *Thecidea papillata* von Schlottheim; Backhaus: 21, pl. 1, figs. 1-4 (see for all references).

TABLE I.

List of the species from the matrix of "*Castanopora*" *jurassica* (Gregory) (D. 180) and *Onychocella piriformis* (Goldfuss) (= *Onychocella bathonica* (Gregory) (D. 181).

I. POLYZOA

	In block with D. 180	In block with D. 181	Maastrichtian Sainte-Colombe*	Néhou*	Fresville	Port Filiollet	Chef du Pont	Maastrichtian of Maastricht
1. <i>Berenicea</i> sp.		+			+			
2. <i>Entalophora benedeniana</i> (von Hagenow) 1851		+					+	+
3. <i>Idmidronea macilenta</i> (von Hagenow) 1851		+	+		+			+
4. <i>Heterocrisina communis</i> (d'Orbigny) 1853		+	+		+	+	+	+
5. <i>Crisisina carinata</i> (Roemer) 1840		+	+		+	+	+	+
6. <i>Osculipora truncata</i> (Goldfuss) 1826		+			+		+	+
7. <i>Reteporidea lichenoides</i> (Goldfuss) 1826		+				+	+	+
8. <i>Petalopora</i> sp.		+				+	+	
9. <i>Multicrescis laxata</i> (d'Orbigny) 1854	+		+					
10. <i>Membranipora unipora</i> (Marsson)		+	+			+		
11. <i>Amphiblestrella elegans</i> von (Hagenow) 1851		+			+	+		+
12. <i>Radulopora minor</i> n. sp.		+				+	+	+
13. <i>Hagenowinella</i> cf. <i>incrassata</i> (d'Orbigny) 1853		+	+		+			
14. <i>Bactrellaria rugica</i> Marsson 1887		+				+	+	+
15. <i>Stamenocella marginata</i> (d'Orbigny) 1852		+	+				+	+
16. <i>Thyracella</i> cf. <i>meudonensis</i> d'Orbigny 1851		+				+	+	
17. <i>Vincularia canalifera</i> von Hagenow 1851		+		+	+	+	+	+
18. <i>Quadricellaria elegans</i> (d'Orbigny) 1951		+				+	+	+
19. <i>Coscinopleura</i> sp.		+					+	
20. <i>Semiescharinella complanata</i> d'Orbigny 1852		+	+				+	
21. <i>Rosseliana thomasi</i> n. sp.	+	+				+	+	
22. <i>Micropora transversa</i> (d'Orbigny) 1851		+		+		+	+	
23. <i>Puncturiella</i> cf. <i>superba</i> Brydone 1936		+			+		+	+
24. <i>Lunulites</i> sp.		+					+	
25. <i>Onychocella nysti</i> (von Hagenow) 1851		+				+	+	+
26. <i>Onychocella</i> cf. <i>cepha</i> (d'Orbigny) 1851		+	+			+	+	
27. <i>Onychocella bellona</i> (d'Orbigny) 1851		+	+	+		+	+	
28. <i>Onychocellaria caecilia</i> (d'Orbigny) 1851		+		+			+	
29. <i>Pliophloea</i> sp.	+							
30. <i>Decurtaria</i> cf. <i>cornuta</i> (Beissel) 1865		+					+	
31. <i>Frurionella fertilis</i> n. sp.		+					+	
32. <i>Beisselina striata</i> (Goldfuss) 1926		+				+	+	+
33. <i>Beisselinopsis flabellata</i> (d'Orbigny) 1852		+	+			+	+	

II. BRACHIOPODA

34. <i>Thecidea papillata</i> (von Schlottheim) 1813		+		+	+	+	+	+
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* After d'Orbigny.

Two small valves of this very common and characteristic brachiopod of the " Craie à Thecidées " were found in the matrix of D. 181. They are indistinguishable from those of the Cotentin Maastrichtian collected by the author. The collection of the " Geologisches Staatsinstitut " Hamburg possesses about 850 specimens from Chef du Pont, Fresville and Port Filiolet, which were studied in the monograph by Backhaus. The locality " Port Fiolet " (Backhaus 1959 : 27 and Hofker 1959 : 369, 380, 381) should be " Port Filiolet ".

STRATIGRAPHICAL RANGE. Maastrichtian, mainly Upper Maastrichtian.

SPECIMENS. BB.42981. Pedicle valve. From the matrix of D. 181. Upper Maastrichtian, Craie à Thecidées, Cotentin, Manche, France.

BB.42982. Small dorsal valve. Horizon and locality as above.

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EXPLANATION OF PLATES

Some of the specimens of Bryozoa and Brachiopoda referred to and figured in this publication are housed in the collections of the British Museum (Natural History) and are prefixed by the letters D and BB respectively.